MECHANICAL ENGINEERING

December, 1958

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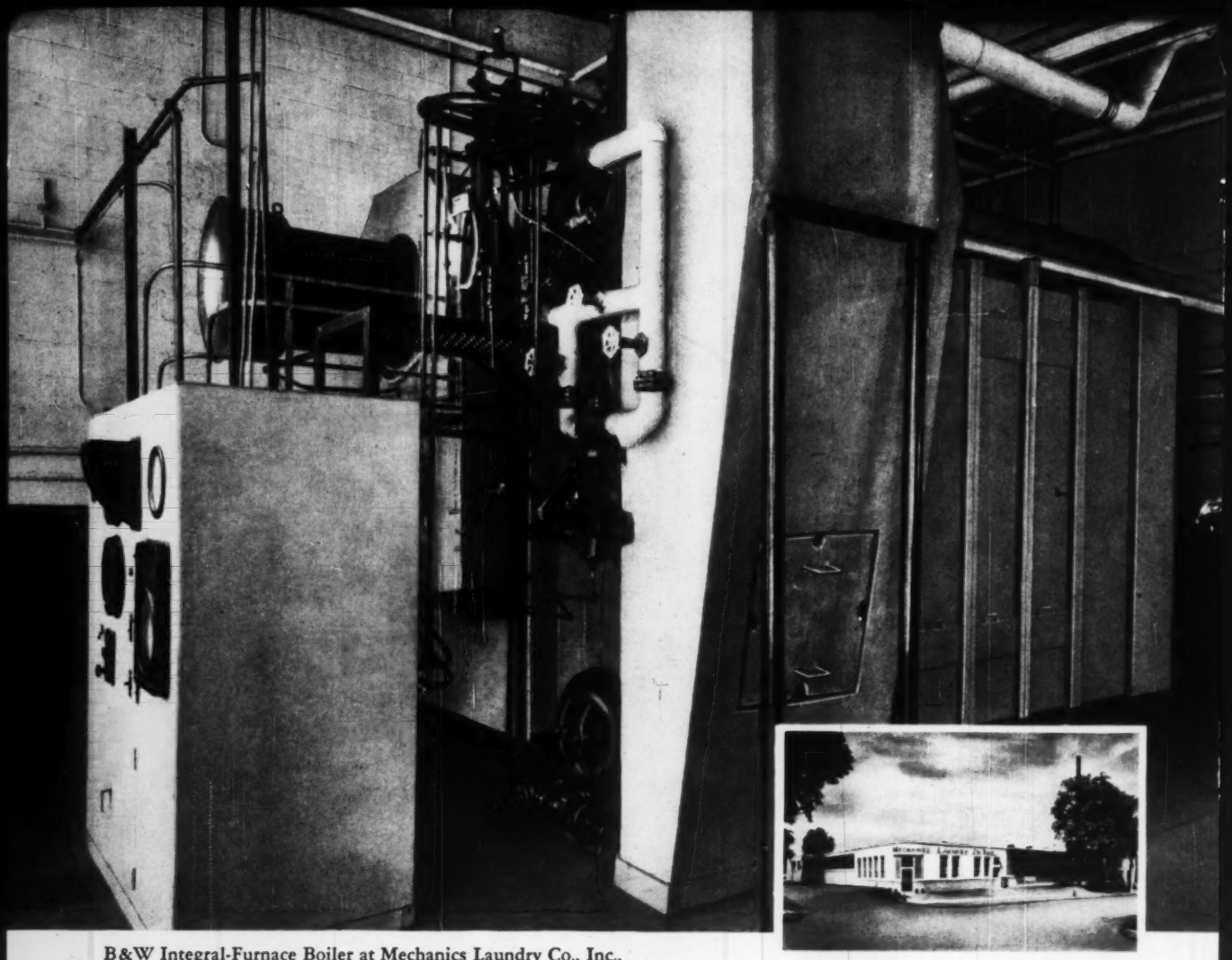


B&W Integral-Furnace Boiler at Mechanics Laundry Co., Inc., Rochester, N. Y., has a capacity of 20,500 lb of steam per hr at operating pressure of 125 psi and design pressure of 250 psi.

B&W INTEGRAL FURNACE BOILER SAVES LAUNDRY $4,000 A YEAR

Cuts Maintenance 90%, Fuel 15% While Meeting Wide Load Swings

Mechanics Laundry Co., Inc., of Rochester, N. Y., is saving an estimated $4,000 a year with its new B&W Integral-Furnace Boiler. The oil-burning unit replaced two old units and has given more steam at higher efficiency in one-half the former space.

Fluctuating Load demand of the industrial laundry ranges from 8,000 to 20,000 lb of steam per hr, several times a day. The B&W unit has met these wide load swings promptly and easily.

Fuel Savings alone amount to $200 a month. Maintenance has been reduced to practically nothing. The unit's response to load swings, its compact design, and operating efficiency are notable.

Continuity of Service and overall economy have been proved for B&W Integral-Furnace Boilers in hundreds of installations. They provide maximum capacity in small boiler room space, high availability, and smokeless combustion. Supported by a national network of plants and engineers, they are designed and engineered from a background of nearly a century of steam generating experience. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-862-1B

BABCOCK & WILCOX

BOILER DIVISION

CASE HISTORIES

N/D achieves maximum axial and radial rigidity by matching two or three super-precision angular contact bearings having different contact angles. See figures 1 & 2 below.
FIG. 1
FIG. 2

Photo: courtesy Ready Tool Company

Bearing Design Helps Live Center Maker Achieve Accuracy of .000050"!

CUSTOMER PROBLEM:

Live center maker requires bearing design that will help achieve . . . and maintain . . . live center accuracy of .000050", under combination radial and thrust loads.

SOLUTION:

After thorough evaluation of the problem, New Departure recommended N/D pre-loaded, duplex ball bearings. Extensive testing proved these super-precise ball bearings resisted combination radial and thrust loads with minimum deflection. The N/D ball bearings, with medium and high contact angles, are mounted duplex and positively clamped together to assure the optimum, pre-determined preload condition. As work expansion increases the thrust load, radial centering becomes more rigid and accuracy is precisely maintained . . . to less than .000050" total indicator run-out!

When you're working on new designs that call for high precision ball bearings, why not call on New Departure? New Departure's consistent precision is your assurance of the ultimate in accuracy for your design. For more information, call the New Departure Sales Engineer in your area or write Dept. U-12.

Available through United Motors System and its independent Bearing Distributors.

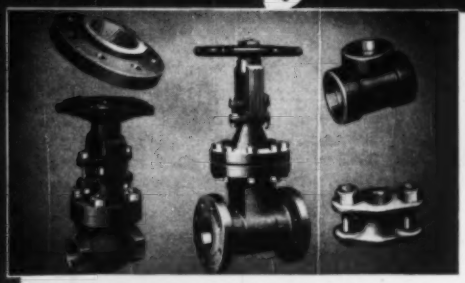
NEW DEPARTURE

DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

NOTHING ROLLS LIKE A BALL

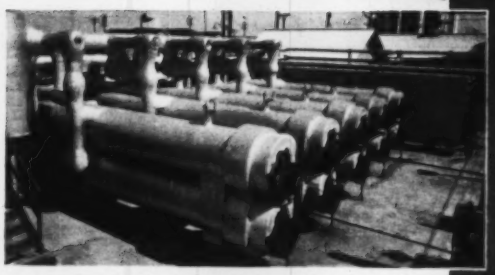
Vogt PRODUCTS

Designed for today's *Tough* service demands



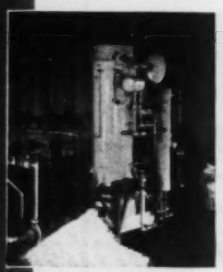
FORGED STEEL VALVES & FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE

Forged from carbon and alloy steels, Vogt valves, fittings, flanges and unions are built to safely handle liquids and gases at high pressures and temperatures in the modern petroleum refinery and petro-chemical plants. The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and weld caps.



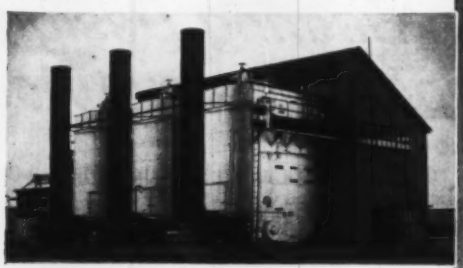
PROCESS EQUIPMENT FOR EVERY SERVICE

Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.



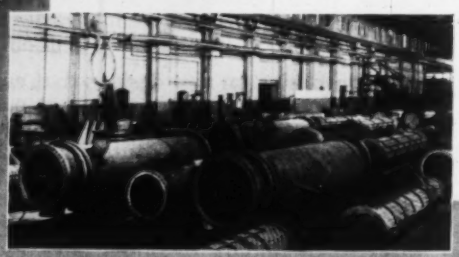
MORE REFRIGERATION TONNAGE AT LESS COST

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Compression Systems and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants and institutions here and abroad.



HIGH EFFICIENCY STEAM GENERATORS

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube and straight tube designs are available for solid, liquid or gaseous fuels to meet every power, process or heating requirement.



SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.

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THE COVER

The man is Dr. T. C. Tsu, Member of ASME and Westinghouse aerodynamicist. The parachutelike object is his model of a space ship to be driven by the sun's rays. The rays exert a slight pressure, and will act on the 0.0001-in. aluminum-foil canopy—its area to be larger than that of the Pentagon Building—like wind on a sail. A rocket launches the vehicle into orbit: The canopy is unfurled, and the small but constant solar pressure accelerates the vehicle to tremendous interplanetary speeds. Orbit-to-orbit time to Mars: 260 days by rocket-propelled ship, 118 days by solar sailboat.

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The authors sought to learn, from the inside, the condition of our scientific research. Herewith their report: The frustrations, attitudes, and motivations that goad our research men.

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Wait a minute: That research project will cost a fortune. Maybe, somewhere in the scientific world, the answer is already on file, the problem already solved. Yes, we can find the reports.

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"B&W helps me match the tube to the job

As a design engineer, I work with all types of steel heat exchanger tubing. B&W can produce all of our requirements, in the grades, sizes and types I need."

It's true. Whatever your steel heat exchanger tubing requirements may be, B&W can meet them promptly and dependably. Take a look at the scope of B&W's operations in this field—seamless and welded stainless steel tubing, seamless and welded carbon steel tubing, seamless alloy steel tubing—with heat treatment, mechanical properties, surface finish, tolerances and length matched to the job.

What's more, B&W district sales offices in principal cities from coast to coast along with three manufacturing locations insure prompt handling of your tubing requirements. You can depend on B&W, too, for assistance in selecting the tube which will meet all of the requisites of fabrication and end use service. Call on Mr. Tubes, your local B&W district sales representative, or write for Bulletin TB-329. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

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A REPORT:

This is growth . . .
healthy growth . . . and a
credit to the power industry.

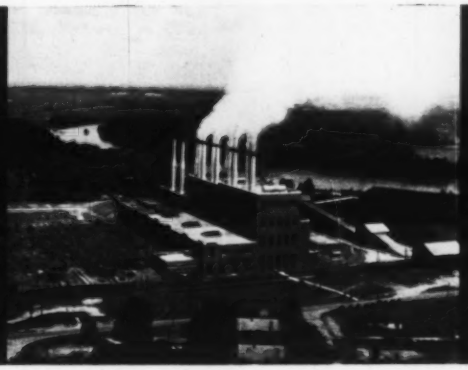
For the past half-century, the Duke Power Company has been serving the Piedmont Carolinas. Today this utility, covering a 20,000 square mile area, has 7 steam and 32 hydro-electric plants with a generating capacity of nearly 2¾ million kilowatts . . . 12 billion kilowatt hours a year. More than ½ million customers are being supplied with instant, dependable power for light, protection and comfort . . . reliable power for successful farming and progressive industry. And the Duke Power Company is expanding rapidly. New units are being constructed constantly. An investment of about $30,000,000. annually goes into this expansion program to service a fast growing area.

Every one of the present 39 power stations now operating this system was designed, constructed and developed by the Duke Power Company engineers. Each plant has been kept modern in every respect. And every one of these stations uses Chapman Valves. Chapman Valves have been used by this system since the turn of the Twentieth Century. They have been used for many sound and practical reasons.

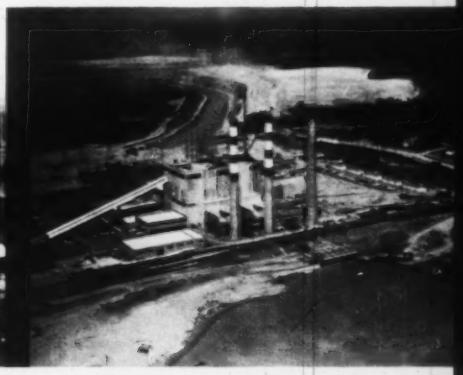
Chapman steel valve . . . 16" x 14" x 16" . . . pressure seal type, 1500 lb. series. Chapman is constantly supplying growing industries with valves for increasingly high pressure and temperature service.

on the Duke Power Company and Chapman Valves

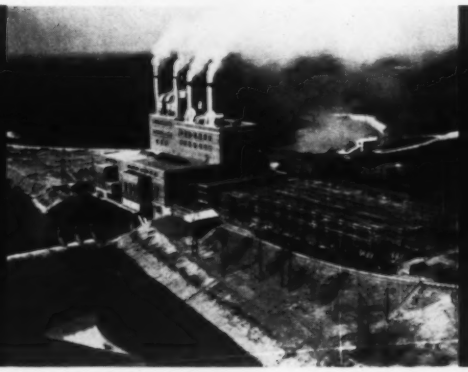
Above: Cliffside units 1, 2, 3, 4. Total kilowatt capacity 220,000.
Below: Buck units 1, 2, 3, 4, 5, 6. 460,000 kilowatt capacity.

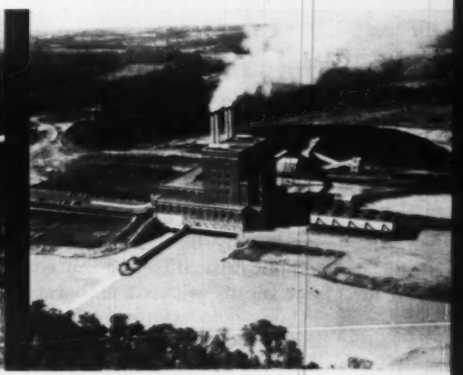


Above: Riverbend units 1-7 with a total capacity of 665,000 kilowatts.
Below: Dan River units 1, 2 and 3. 300,000 kilowatts total capacity.



Above: Allen Steam Plant — Two additional units now under construction.
Below: Lee units 1 and 2. 385,000 kilowatts. Unit 3 opens December 1958.





The CHAPMAN VALVE *Manufacturing Company* INDIAN ORCHARD, MASSACHUSETTS

Study the record of The Chapman Valve Manufacturing Company for the past 75 years and you'll find the many reasons why Chapman Valves are used by Duke Power and many other important Companies in many fields of endeavor. Chapman designs, develops, produces and delivers valves — that meet the requirements of today and of tomorrow. A consultation between Chapman engineers and yours, with no obligation to you, is sincerely recommended. Simply write . . . today, anytime, soon.

Weldability—Welding is the only technique that we can use to join two pieces of metal so that they act as a single piece of metal.

Not *all* metals. Steel stands alone as the most weldable of all practical metals. Not *all* steels, but most of them can be welded without any sacrifice of strength or elastic behavior. More than that, steel can usually be welded without special precautions, without critical timing procedures, without excessive heat input, without elaborate and corrosive fluxes, without color change in the base metal, and with little danger of cracking. Welding engineers deserve most of the credit for the fact that steel can be welded so easily. With their help, steel producers have made many important break-throughs.

Before the 1930's, carbon and manganese were the main strength-producing elements in steel. Designers wanted stronger steels so they could build lighter structures—and they wanted to *weld* these steels because there is no lighter fastening system. But as the carbon content was raised to strengthen the steels, the weldability decreased and designers were handicapped because they had to fasten "lightweight" high carbon steels with heavy rivet and gusset-plate assemblies.

In 1933 United States Steel introduced the first *low carbon*, high-strength, low-alloy steel—USS COR-TEN Steel—and later USS TRI-TEN Steel. Both steels achieved 50,000 psi minimum yield strength with alloying elements other than carbon, and could be welded with normal procedures. The world of alloy steels was brightened, too, with the introduction a few years ago of USS "T-1" Steel, a constructional alloy steel combining tremendous strength (100,000 psi min. yield strength), toughness *and* weldability without requiring preheating or stress relief.

No matter what combination of properties you desire in a steel, there is a weldable steel that will do the job. In fact, there is theoretically *one* best steel for any application, and it can be selected from our family of Steels for Design: Carbon, High Strength, Alloy and Stainless. If you could use help in finding it, check United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

United States Steel Corporation • American Steel & Wire • Columbia-Geneva Steel • National Tube
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USS United States Steel

STEELS FOR DESIGN

Lower Left—Problem: Design butt-weld fittings for high-pressure oil and gas lines. Solution: Designer used USS TRI-TEN Steel, a high-strength, low-alloy steel particularly noted for its weldability. Pay-off: Fittings made lighter due to thinner plates; welding was fast and easy; less weld metal was needed; and the weld was as strong as the parent metal.

Lower Middle—Problem: Build a bedplate for a printing press requiring 534 welds. Solution: Builder used USS "T-1" Constructional Alloy Steel. Pay-off: Tremendous strength and toughness of "T-1" withstands thunderous impact from high-speed printing rollers and cutting knives—*and not one weld has failed.*

Lower Right—Problem: Convert a concrete reservoir into a storage area for 2,000,000 gallons of ammonium nitrate. Solution: Reservoir was lined with corrosion-resistant USS Stainless Steel sheets. Pay-off: Quick, easy installation because the Stainless sheets were welded right on the job—3½ *miles* of lap seams were welded and only two tiny imperfections were found when the welds were vacuum tested.

USS, "T-1," Cor-Ten and Tri-Ten are registered trademarks

"Flexhot"

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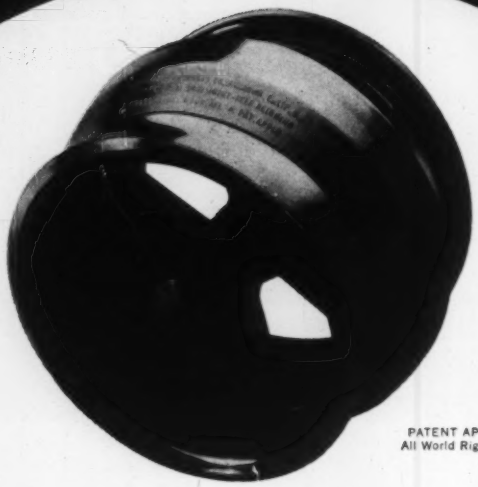
SELF-ALIGNING ★ HIGH TEMPERATURE



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1. 360° of Axial Rotation While Inline or Misaligned. ★ 2. Operating Pressure Range 0 to 110 PSI Gage.
3. Axial Deflection up to 10° Included Angle Between Ends. ★ 4. Positive Maximum Angular Control.
5. Minimum Bending Moment. ★ 6. Operating Temperature Range —65°F. to 550°F. Internal Air.
7. Minimum Torque. ★ 8. No Lubrication Required for the Life of the Unit.
9. Adaptable to Marman, Janitrol & Bolted Type Flanges. ★ 10. Minimum Pressure Drop.
11. 165 PSI Gage @ 550°F. Proof Pressure. ★ 12. Long Life.

SOUTHWEST PRODUCTS CO.

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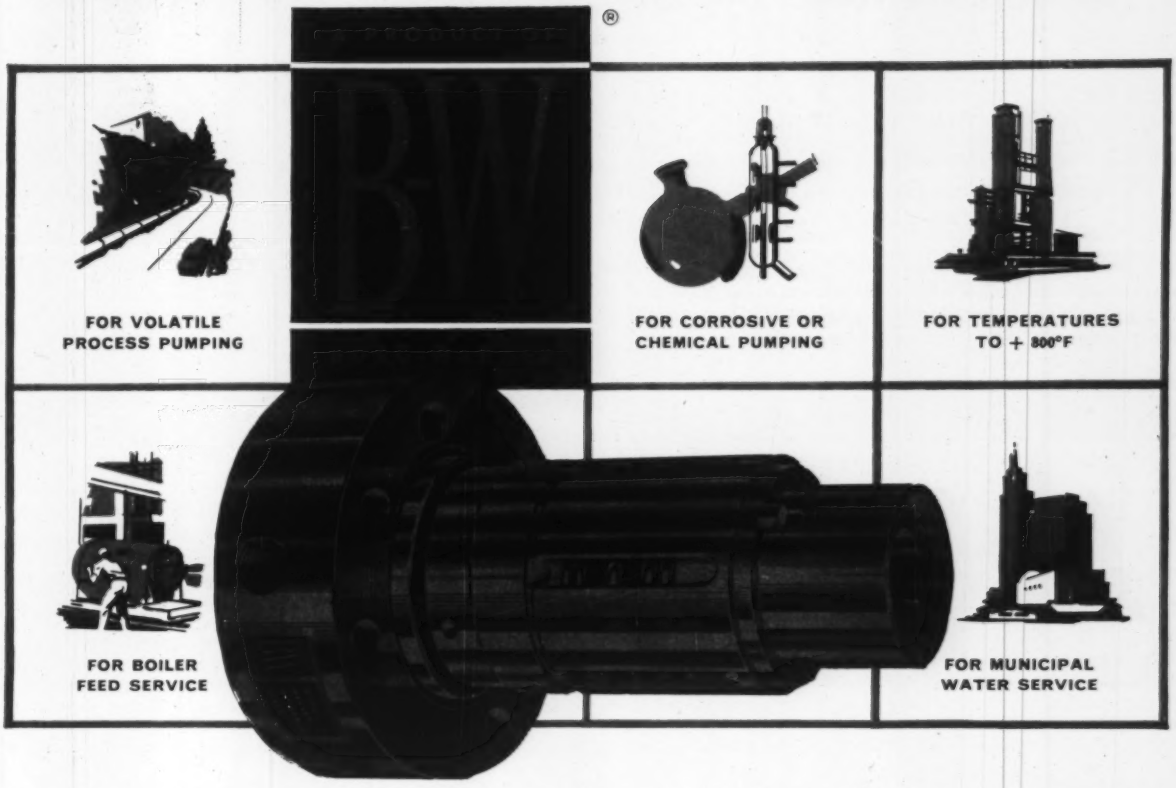
Now...Borg-Warner® Mechanical Seals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FOR BOILER FEED SERVICE
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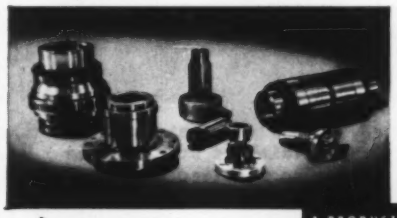
Precision shaft seals for all makes and models of centrifugal pumps...and other rotating shaft sealing applications



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Because of their wide acceptance and rapid growth, the complete line of mechanical seals—developed and perfected by Byron Jackson—now becomes a separate, industrial division of Borg-Warner.

Borg-Warner Mechanical Seals are now available for almost every make, model and size centrifugal pump... almost every pumping condition... and for other difficult rotating shaft sealing applications.

Even under critical conditions of pressure, volatility, toxicity, corrosion, abrasion and other tough fluid handling jobs, these precision mechanical seals furnish completely reliable stuffingbox performance. They're easy to install and maintain... eliminate expensive downtime and repacking.

This new Borg-Warner Mechanical Seal Division provides larger, more efficient sales, engineering, manufacturing and service facilities. It concentrates an even greater research and development program to create new and improved seals for tomorrow's shaft sealing needs.

Send for the new Borg-Warner Mechanical Seal bulletin—there's no obligation!

Borg-Warner Mechanical Seals

Division of Borg-Warner Corporation

P.O. Box 2017A, Terminal Annex, Los Angeles 54, California

rigid specifications

Tension tests are required to be made at room temperatures and at 670° F. The following minimum physical properties shall be met:

At Room Temperature:

TS	YS	EL	RA	CHARPY V-NOTCH
70,000	30,000	45	50	50

At 670° F. the minimum tensile strength shall be 51,000 p.s.i. and the minimum yield strength 18,300 p.s.i.

Rejection

Each casting that develops unacceptable defects during shop working or fails to conform to all of the requirements of these specifications shall be rejected. No repair by welding or other means will be permitted.

All cast pipe shall be hydrostatically tested to 5,900 p.s.i. and held at that pressure for 20 minutes with zero pipe leakage. Each length of pipe shall be hydrostatically tested at the manufacturer's plant.

Radiographic Inspection

(a) Paragraph S5 (a) of the Supplementary requirements of ASTM-A 362-52T.

(b) All castings shall be radiographed 100% and shall conform to ASTM-E7 1-52, Class 2 quality, except as modified by these specifications.

(c) The manufacturer shall establish a positive system of identification of the X-ray plates which shall be subject to approval by the inspector. This system shall guarantee complete coverage by radiographing and provide for positive identification between the plate and the subject.

Inspection of Penetrants

All castings shall be subjected to inspection by fluorescent penetrants or penetrating dyes both inside and out. All cracks, porosity, or flaws revealed as a result of the Dye Penetrant Test shall be due cause for rejection of the casting.

The 304L stainless steel shall conform to the following ladle analysis:

Carbon	.03 max.		
Manganese	1.50% max.		
Phosphorous	.03% max.		
Sulphur	.03% max.		
Silicon	2.00% max.		
Chromium	18.00	-	21.00%
Nickel	8.00	-	11.00%

Pipe: All pipe of the following sizes shall be centrifugally cast stainless steel as per ASTM-A 362-52T, except as modified by these specifications:

16" - Sch. #160
12" - Sch. #160
10" - Sch. #160
8" - Sch. #140

All pipe shall be machine finished to 125 micro-inch interior and exterior.

for nuclear piping met by U.S. PIPE metal mold process

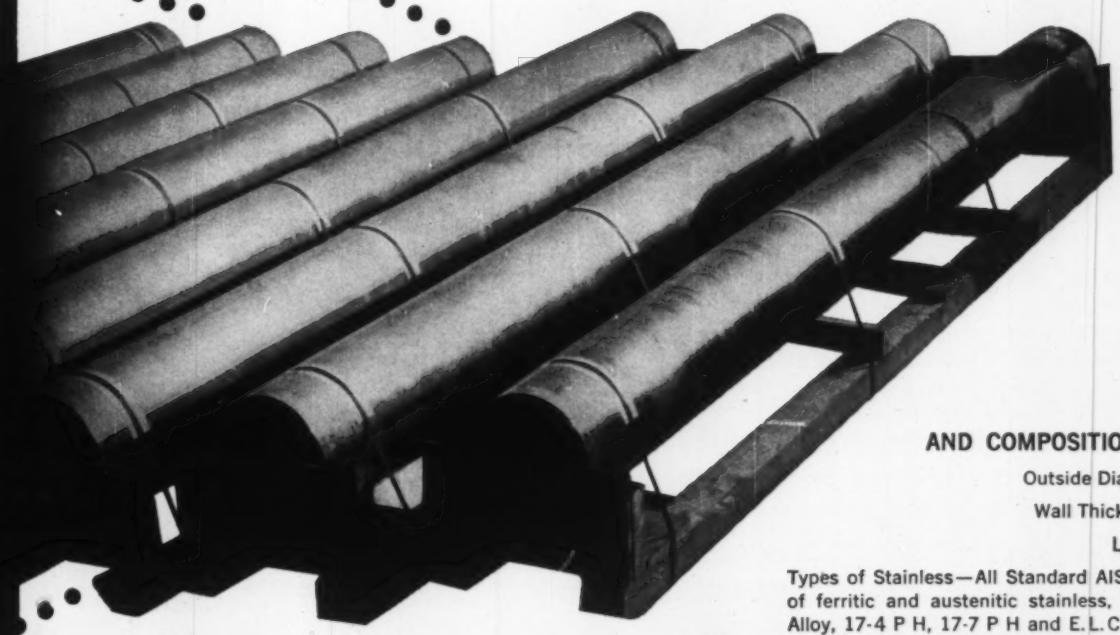
Centrifugally Cast Stainless Steel Solves Many Piping Problems

Combinations of temperatures, pressures and corrosive conditions never encountered before: these are among the piping problems that must be overcome by the men who design the nation's nuclear power installations.

Stainless steel centrifugally cast pipe provides many of the answers. Study the specifications at the left . . . specifications demanded of stainless steel pipe on a recent job for Paul Hardeman, Inc., Los Angeles, California. This pipe is being used for heavy duty, high pressure, elevated temperature service in the primary piping system of the SPERT-III Reactor at the U. S. Atomic Energy Commission's National Reactor Testing Station near Idaho Falls, Idaho. The Stearns-Roger Mfg. Company, Denver, Colorado, is the architect-engineer on this project. A complete tabulation of the actual test data obtained on this pipe and to this specification is available upon request.

U. S. Pipe is headquarters for metal mold centrifugally cast alloy and stainless steel pressure pipe over a wide range of special and standard analyses—in large and small quantities—and to individual specifications.

If piping of the type described above is the bottleneck in your nuclear power planning, write and outline the problem.



SIZE RANGE AND COMPOSITION FLEXIBILITY

Outside Diameter—6" to 50"

Wall Thickness—⅜" and up

Length—Up to 16'

Types of Stainless—All Standard AISI and ACI grades of ferritic and austenitic stainless, including No. 20 Alloy, 17-4 P H, 17-7 P H and E. L. C. grades.

UNITED STATES PIPE & FOUNDRY CO.

Steel and Tubes Division

BURLINGTON, NEW JERSEY

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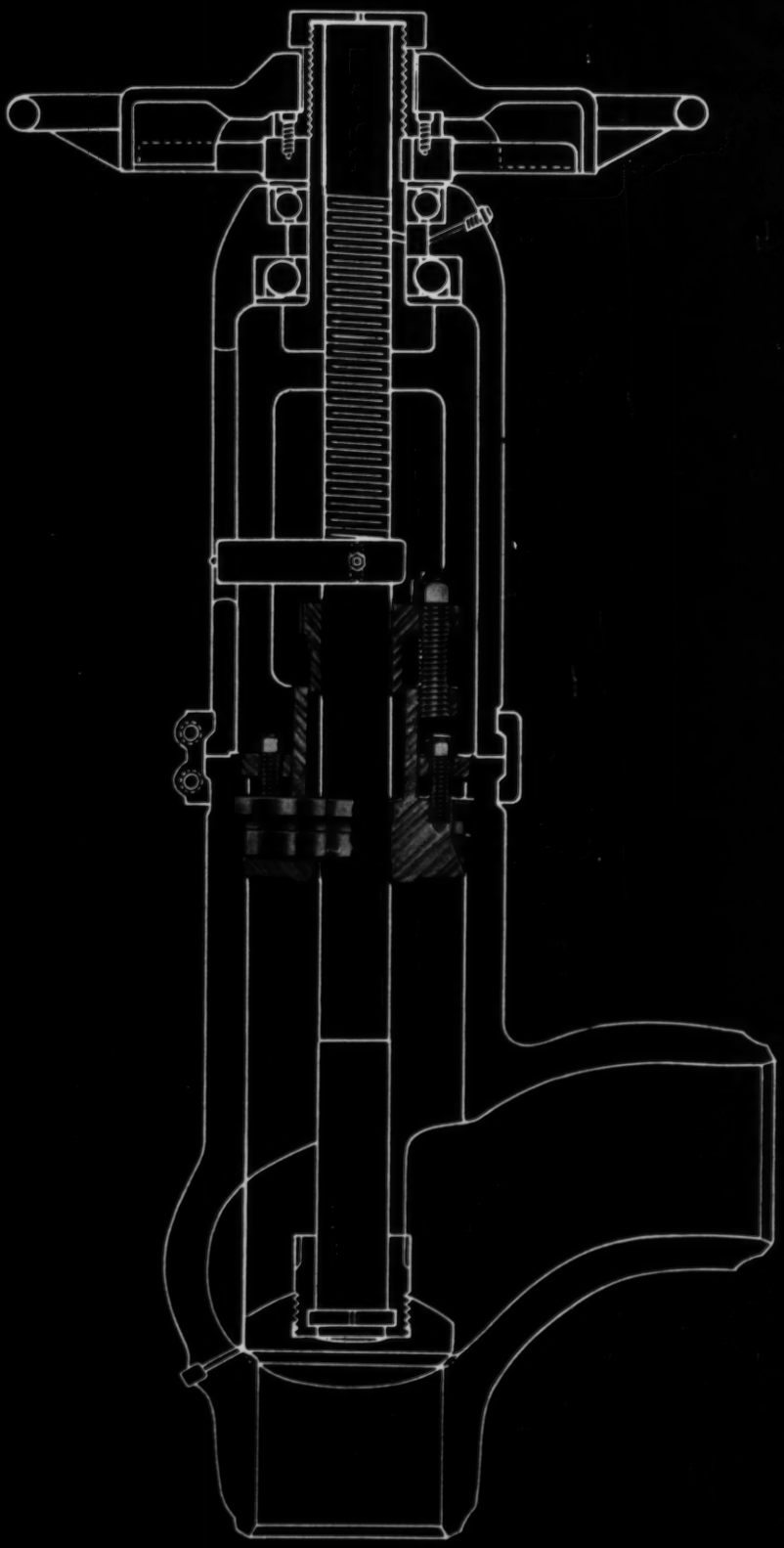


EDWARD PRESSURE-SEAL ANGLE VALVE

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

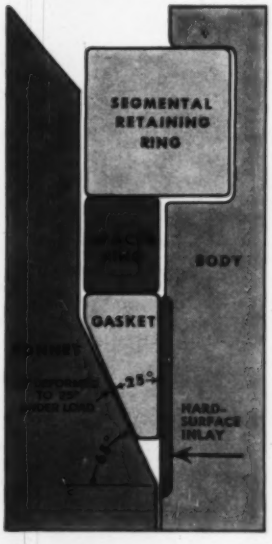
Not A Single Failure Reported In 5 Years

on unique "Pressure-Seal" body-bonnet joint!*

Advances in service temperatures (above 800 F) led to introduction, in 1945, of commercial steel valves with pressure-seal bonnet joint construction. These superseded bolted joint valves of earlier design.

The original 45° pressure-seal gasket, used by Edward and other manufacturers, was a significant improvement in minimizing leakage. But scientists in the Edward Research Laboratories refused to accept this as the best that could be done, set out to develop a better pressure seal joint.

In 1953 Edward research paid off: a completely new Edward pressure-seal design—with 25°–65° joint—was introduced. Design is shown in diagram on this page. The change in gasket angle, plus other Edward improvements described here, brought an end to bonnet joint leakage in pressure-seal valves.



Literally thousands of Edward pressure-seal valves have been installed since 1953 in a great variety of services. Of these, *not a single case of failure has ever been reported.*

Here's Why Edward Improved "Pressure-Seal" Succeeded:

SEALING AREA MULTIPLIED!
Improved gasket design *triples* sealing surface area, virtually eliminates possibility of leakage.

SEALING FORCE DOUBLED!
Angular relationship of bonnet, gasket and body directs more line load *outward* against the gasket, doubles sealing force.

SPECIAL GASKET SEAL-COATING!
A special corrosion-resistant malleable coating (.001 inch thick) is applied to gasket, flows into minute irregularities, assures perfect seal.

IMPROVED BODY SEALING SURFACE!
Possibility of any microscopic casting porosity in vital body-gasket sealing zone is avoided by inlay of corrosion resistant hard-surfacing material.

EASY DISASSEMBLY!
Body bore has been enlarged just above gasket area; this permits gasket to be easily lifted out, after segmental retaining ring and spacer are removed.

GASKET DAMAGE ELIMINATED!
Sharp edge of gasket has been rounded-off, eliminates possible damage to gasket during handling or storage.

EDWARD VALVES, INC.

1228 West 145th Street, East Chicago, Indiana

Subsidiary of

ROCKWELL MANUFACTURING COMPANY

Represented in Canada by
LYTLE ENGINEERING SPECIALTIES, LTD., 360 Notre Dame St. W., Montreal 1, Que.

Edward builds a complete line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.

*T. M. Reg. U. S. Pat Off.

BERGEN GETS 8 LJUNGSTROMS®
...AND SOME REMARKABLE CUSTOMER SERVICE

Public Service's new Bergen Generating Station will be served by 8 large, horizontal Ljungstroms. Almost as important . . . the Ljungstroms will be serviced *throughout* their life by Air Preheater.

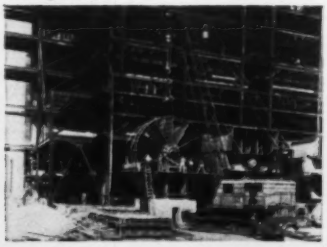
What's special about this customer service? For one thing, it's the considerable knowledge and talents of Air Preheater's engineers. They have been involved in nearly every conceivable type of boiler/preheater problem. They've seen how these problems can be handled. And they can put this experience to work for operators of Ljungstrom air preheaters.

Your Air Preheater engineer also makes regular calls to check the operation of every Ljungstrom – for as long as it's in service. (This now includes installations dating back to 1923.)

So, when you select a Ljungstrom, you're never entirely on your own. You *continue* to be the responsibility of a competent Ljungstrom engineer and benefit from his experience and knowledge. Maybe that's why 9 out of 10 preheaters sold are Ljungstroms.

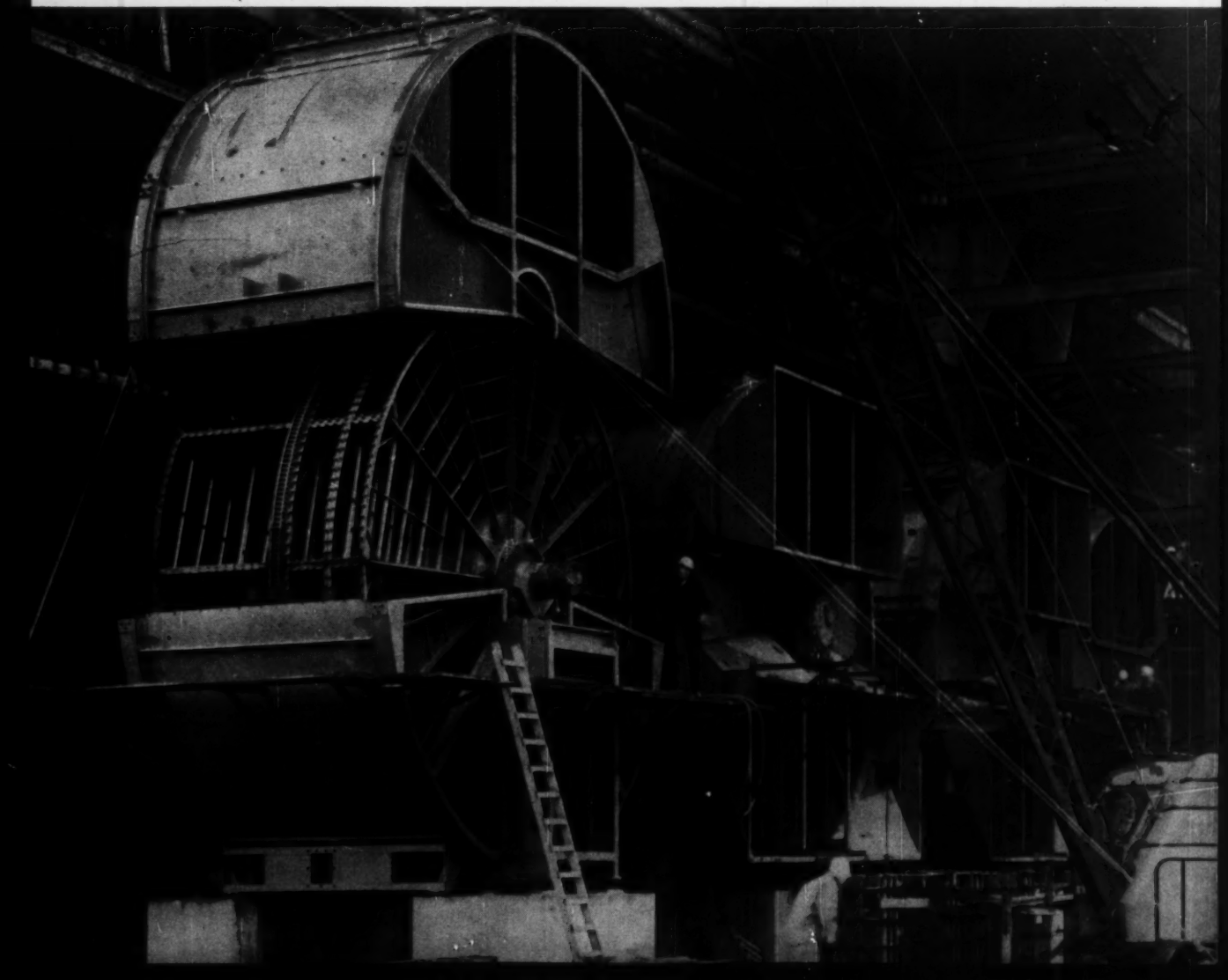
Thirty-five tons of Ljungstrom rotor being lowered into place at the new Bergen Generating Station at Ridgefield, N. J. (When the heating elements are installed the rotor will weigh 150 tons.) This is one of eight preheaters being installed by Public Service Electric and Gas Co. to serve two boilers – each evaporating 1,900,000 lbs of steam/hr. The first boiler is to be fired early next year. Anticipated preheater outlet temperature is about 275 F.

Public Service is one of the first Northern utilities to use large-size horizontal preheaters. They have nine such horizontals in operation at their Linden Generating Station and have ordered eight more for their new Mercer Generating Station.



THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.



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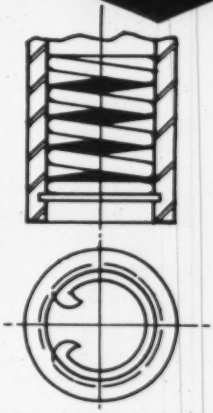

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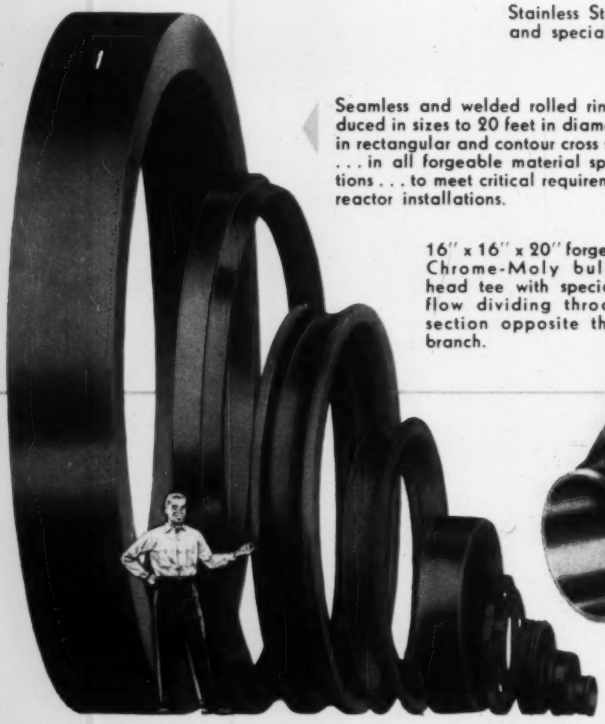
... THE RECOGNIZED, DEPENDABLE SOURCE FOR

18" alloy steel elbows with 3.9" wall for extremely high pressure-temperature service.

Heavy wall laterals closed impression die forged of Stainless Steel in a variety of sizes.

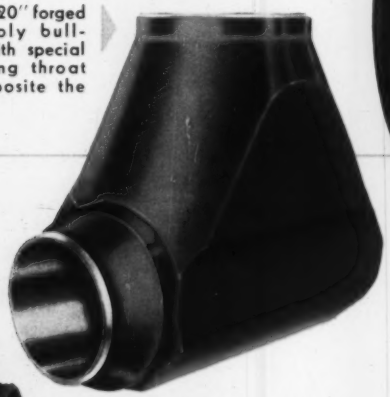
Stainless Steel, heavy wall, reducing tee with extended run section.

Stainless Steel Elbow with heavy wall and special radius for nuclear service.



Seamless and welded rolled rings produced in sizes to 20 feet in diameter . . . in rectangular and contour cross sections . . . in all forgeable material specifications . . . to meet critical requirements of reactor installations.

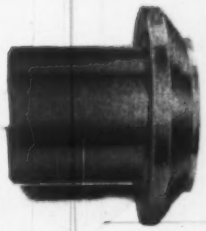
16" x 16" x 20" forged Chrome-Moly bull-head tee with special flow dividing throat section opposite the branch.



Heat exchanger tube sheet of Stainless Steel. Forged weight — 4220 pounds.

Unusual Fittings

FOR NUCLEAR AND CONVENTIONAL POWER PIPING APPLICATIONS



Type 304L Stainless Steel Nozzle, drop forged and machined to precision tolerances.

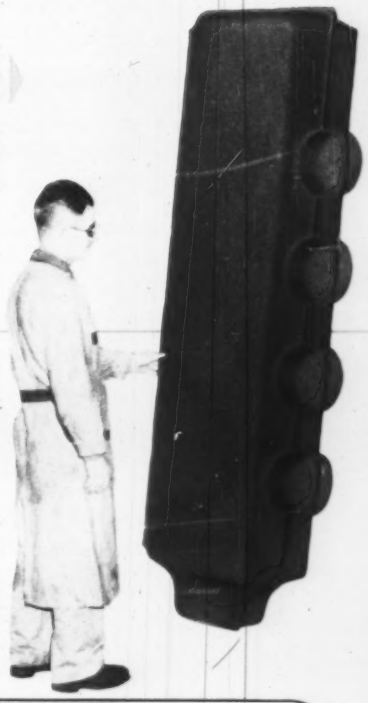
Titanium pipe fittings produced for a number of critical piping installations requiring positive resistance to extremely corrosive media.

Ladish is widely recognized as a prime, dependable source for a broad range of special-purpose fittings and forgings to meet unusual piping problems.

The fittings shown here were developed in close collaboration with the engineering staffs of firms pioneering in the design of modern conventional power plants and nuclear power installations.

Ladish has extensive experience and unequalled facilities for forging, machining and testing . . . small and large, simple and complex parts, in virtually every forgeable material . . . under precise metallurgical and manufacturing controls.

Largest closed impression die forging produced to date. Weight — 10,500 pounds . . . 316 Stainless Steel. For use in modern power plants operating at elevated pressures and temperatures.



L

TO MARK PROGRESS

Intricately shaped Stainless Steel heat exchanger heads. Drop Forged and machined to close tolerances by Ladish.

LADISH CO.

CUDAHY (Milwaukee Suburb) WISCONSIN

Serving the West . . . Ladish Pacific Division, Ladish Co., Los Angeles, Calif.
Serving Canada . . . Ladish Co. of Canada Ltd., Brantford, Ontario

Complete Service in *Controlled Quality* Fittings

WELDING FITTINGS	ASA & MSS FLANGES	SCREWED and SOCKET FITTINGS and UNIONS	LONG NECK FLANGES	TEMA & LARGE O.D. FLANGES & ROLLED RINGS

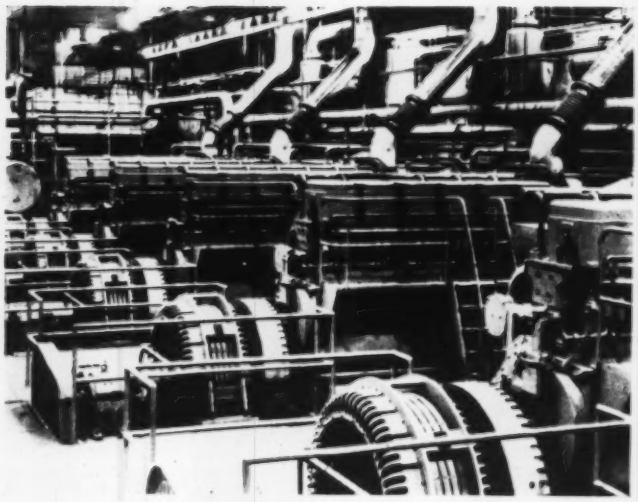
(official U.S. Air Force photo)

NORDBERG ENGINES help power SAGE System Direction Centers of the Air Defense Command

"Master-minding" the tactical operation of U.S. Air Force interceptors like this F-102 jet is an amazing electronic air defense system called SAGE . . . *Semi-Automatic Ground Environment.* By analyzing a variety of air surveillance information which is received from a vast network of facilities and fed into electronic digital computers located at its Direction Centers, the SAGE System computes the speed, altitude, and direction of planes in flight to facilitate identification. A picture of the air and defense situation is displayed so clearly that Air Force personnel can quickly decide when and where to intercept, should aircraft be identified as suspect. The system also monitors the deployment of selected air defense weapons.

The Direction Center computing and display equipment relies on station-generated electric power. To help assure adequate power at all times, Nordberg Diesels have been installed in several Direction Centers.

Nordberg Mfg. Co., Milwaukee 1, Wisconsin



Nordberg four-cycle diesels installed in one of the SAGE system centers, generating electric power for the electronic computers, communications equipment, etc. Each of the Nordberg supercharged 6-cylinder engines is rated 930 hp at 450 rpm and is monitored electronically.

NORDBERG

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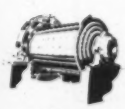
MINE HOISTS



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Some Ideas

for your file of practical information on drafting and reproduction from

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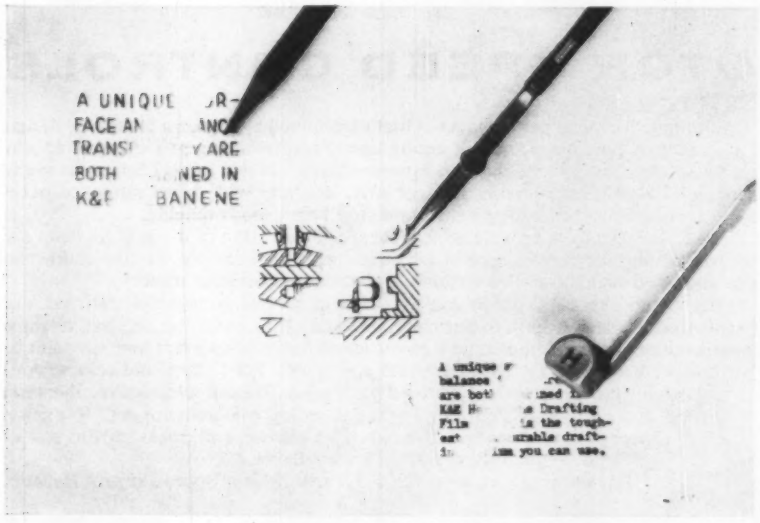

Now you see it . . . now you don't. Pencil, ink and typing all register sharply, erase completely on the K&E "engineered surface."

The K&E "Engineered Surface"

All K&E paper, cloth and film has one extremely individual characteristic. It's what K&E calls its "engineered surface"... a unique surface designed and applied by K&E, right in its own plant, to every roll and sheet of prepared tracing paper, cloth and film. It means controlled drafting qualities far beyond anything the base material alone can normally provide, with a surface tooth that's exactly right and uniform. Whatever's penciled, inked or typed onto it goes on crisply and sharply . . . shows up clearly and stays that way. Furthermore, the "engineered surface" lets you erase if you want to, easily and quickly and without any of those leftover ghost lines that drive you crazy when they show up in reproductions. And remember, only with K&E do you get all the advantages of an "engineered surface," no matter which paper, cloth or film you're interested in.

About HERCULENE (TM) The Newest of Films

Frankly, we think K&E Herculene Drafting Film is a real discovery. It has all the properties of the K&E "engineered surface" . . . exceptional "take," adhesion and erasability . . . plus the toughness and durability of its Mylar® base. What's the latter? It's a polyester film, developed by DuPont, that's uncommonly strong and virtually indestructible . . . waterproof and almost immune to the effects of age, heat, ultraviolet exposure and handling. With our K&E "engineered surface" added, it becomes K&E Herculene Drafting Film . . . the toughest, most durable drafting medium yet to reach the drafting room. And the surface will last indefinitely, without flaking off or chipping off.

Some Points About Paper...

K&E Albanene® Tracing Paper is the largest selling tracing paper in the world today. Why? Because Albanene is the *only* prepared tracing paper which has an "engineered surface." All other brands depend for their pencil tooth solely on the natural surface texture of the paper itself, which varies from fine to coarse . . . often on the same sheet.

Albanene invariably gives you sharp, clear pencil lines, superb reproductions. It has a solid transparentizer that is chemically stable and can't leak out, ever. This permanent transparentizing means that you'll never get white, opaque spots, even from contact with drafting tape. Try the drafting tape test yourself.

...and its package

And now, all Albanene paper in rolls is packaged in the new square carton for better protection and easier storage. Your rolls stay neat and clean while in use, and the cartons will do double duty in helping you to store finished tracings. In fact, some companies are rearranging their filing systems by using Albanene cartons, which hold large numbers of rolled-up drawings and stack simply and neatly.

Some Facts About Cloth

When you want cloth, think first of K&E Phoenix® Tracing Cloth. Besides the K&E "engineered surface" with the superb "take", adhesion and erasability for pencil, ink or typing, K&E Phoenix has all the advantages of a water-resistant, chemically-inert coating that won't soften even under high heat and won't discolor, become brittle or flake off the base. You can even clean both sides with a damp cloth, without worrying about moisture stains.

And Some Tips On Erasing

All K&E drafting media give you excellent erasability, but there's a right way to erase on each one. On cloth and film, harsh, gritty erasers can destroy the surface. You'll get the best results with plastic erasers, such as the Richard Best "Tad" and the Eberhard Faber "Race Kleen." Moisten them for removing ink and stubborn typing; use them as they are for removing pencil lines. Large areas of ink can be removed completely without damage by using a moist cloth and Bon Ami cleanser. On Albanene, electric erasing machines are fine if used with a soft eraser.

The Choice Is Up To You

When it comes to selecting K&E paper, cloth or film for the job at hand, we have to leave the choice to you. We're not being indecisive . . . it's just that you're the only one who knows the particular problem you have and which product solves it best. But remember . . . K&E has a *complete* line of paper, cloth and film . . . and only K&E puts a special "engineered surface" on all three media to provide a well-balanced, uniform surface suited to the base material.

KEUFFEL & ESSER CO., Dept. ME-12, Hoboken, N. J.

Please send me more information and samples on the following:

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MOTOR SPEED CONTROLS

Optimum mechanical performance is best determined by testing a prototype design at a variety of possible operating conditions. Features inherent in Variac Motor Speed Controls ideally suit them to experimentation of this kind. Their great use in this type of work is attributable, in large part, to a very wide speed range, constant output torque, and the ability to start and stop heavy loads quickly.

These Speed Controls provide adjustable speed operation of d-c motors from a-c lines, combining the convenience of a-c power with the excellent starting characteristics and good regulation of d-c shunt- and compound-wound motors.

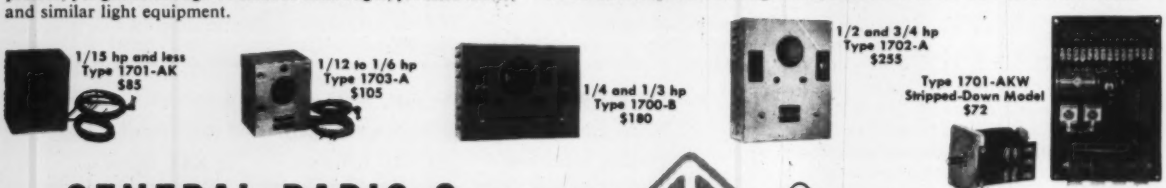
Variac Motor Speed Controls are available in several horsepower ratings: one fifteenth and less, one twelfth to one sixth, one quarter to one third, one half to three quarters with choice of compact unit construction for installation at control point or stripped-down design for use in original equipment. Start, stop, and reverse controls are included, as well as overload protection. Rugged selenium rectifiers are used, and make possible quick starting, very low maintenance, and low price. There are many models from which to choose, and prices start as low as $72.00 — quantity discounts are available.

For information, write for our Variac Motor Speed Control Bulletin.

G-R one-third horsepower Variac Motor Speed Control drives rollers of a readout prototype for a Burroughs high-speed computer. The effects of roller shape and roller material on acceleration of paper samples is readily determined by noting paper slippage at different starting speeds set by the Speed Control. Optimum mechanical design consistent with maximum speed is thus arrived at in minimum time.

Versatile Variac Motor Speed Controls are used in a wide variety of applications. They are rugged enough to control high-speed grinders and drills, lathes, milling machines and punch presses, yet gentle enough to control centrifuges, jewelers lathes, and similar light equipment.

Photo Courtesy The Burroughs Corporation Research Center at Paoli, Penna



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For Sealing Performance You Can Depend On

For nearly fifty years, there has been one uniquely resilient seal with a spring-action that adjusts to every change in operating conditions. It's the Flexitallic Spiral-Wound Gasket . . . identified for engineers by the blue dye in the Canadian asbestos filler.

In Flexitallic Spiral-Wound Gaskets, compression response is directly related to bolting for each application. With the desired gasket design determined, exacting mechanical controls assure that manufactured gaskets conform to specification.

Flexitallic Spiral-Wound Gaskets serve under the most rigorous operating conditions — from vacuum to 6,000 lbs., from extreme sub-zero to 2000°F. The amazing flexibility of the Flexitallic Gasket makes flanged joints leak-proof even after severe thermal shock, vibration, chemical attack, and cyclic operation.

That's why: for sealing performance you can depend on, it pays to put "Flexitallic" in the blueprints.

FLEXITALLIC GASKET CO.
8th & Bailey Sts. Camden 2, N.J.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered tradename. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

The MARSH way is the SURE way—

You'll have a new conception of how *uniformly good* radiator valves, traps and vents can perform when you make the job Marsh all the way through.

Take the Radiator Valve and Trap illustrated here, for instance:

The Marsh Radiator Valve is *truly* packless—not just *called* packless. This valve has no "packing" whatever... instead, the ingenious Marsh annular mechanical seal that keeps it drip tight throughout its far longer life.

And Marsh Radiator Traps are equally sure-footed... have the famous Marsh Diaphragm—extremely rugged, but so sensitive that it never fails to close tight on steam, yet opens instantly to pass condensate and air at only a few degrees below closing temperature.

Yes, the Marsh way is the sure way... Valves, Traps, Vents, F & T Traps, designed, built and tested to give lasting satisfaction in the Marsh tradition. Ask for up-to-date Heating Specialties Catalog 76-H.

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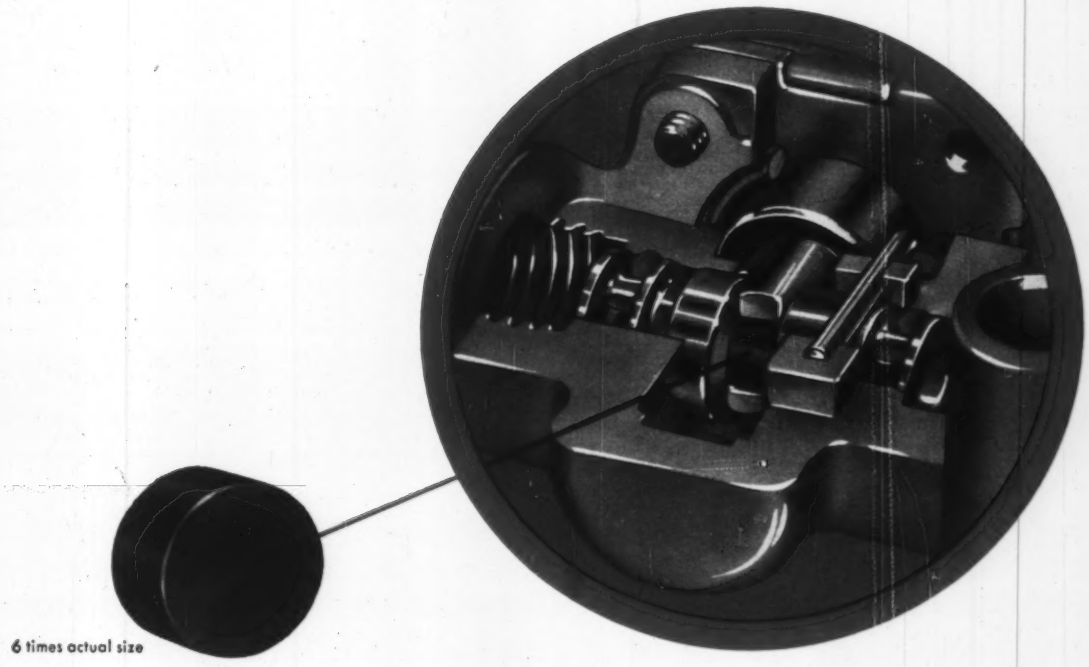


6 times actual size

FOR PRECISION OPERATION

VALCOR solenoid valve relies on a self-lapping GRAPHITAR® disc.

(CARBON-GRAPHITE)

These solenoid valves manufactured by Valcor Engineering Corp. of Kenilworth, New Jersey, incorporate a "floating seal" of GRAPHITAR, and are helping to launch the new age of guided missiles in America. Over half a million Valcor valves are in use in military aircraft and guided missiles today.

The heart of the "floating seal" solenoid valve is a precise, optically flat, GRAPHITAR disc which floats in the plunger. A slight pressure, from either direction, moves the disc against an equally optically flat, stainless steel seat, sealing perfectly. The solenoid valve actually improves with use, due to its unique self-lapping action.

GRAPHITAR has many unusual properties that make it an ideal material for such challenging applications. It is nonmetallic; resists chemical attack; is mechanically strong, yet extremely light in weight. GRAPHITAR will not warp and extreme changes in temperature cause virtually no expansion or contraction. Probably the most important of GRAPHITAR'S advantages are its self-lubricating properties and low coefficient of friction.

Today design engineers are solving many different problems by using GRAPHITAR, a most unusual and versatile engineering material. Perhaps GRAPHITAR is the perfect material for your product. Our competent staff of engineers can assist you in applying GRAPHITAR to your particular needs.

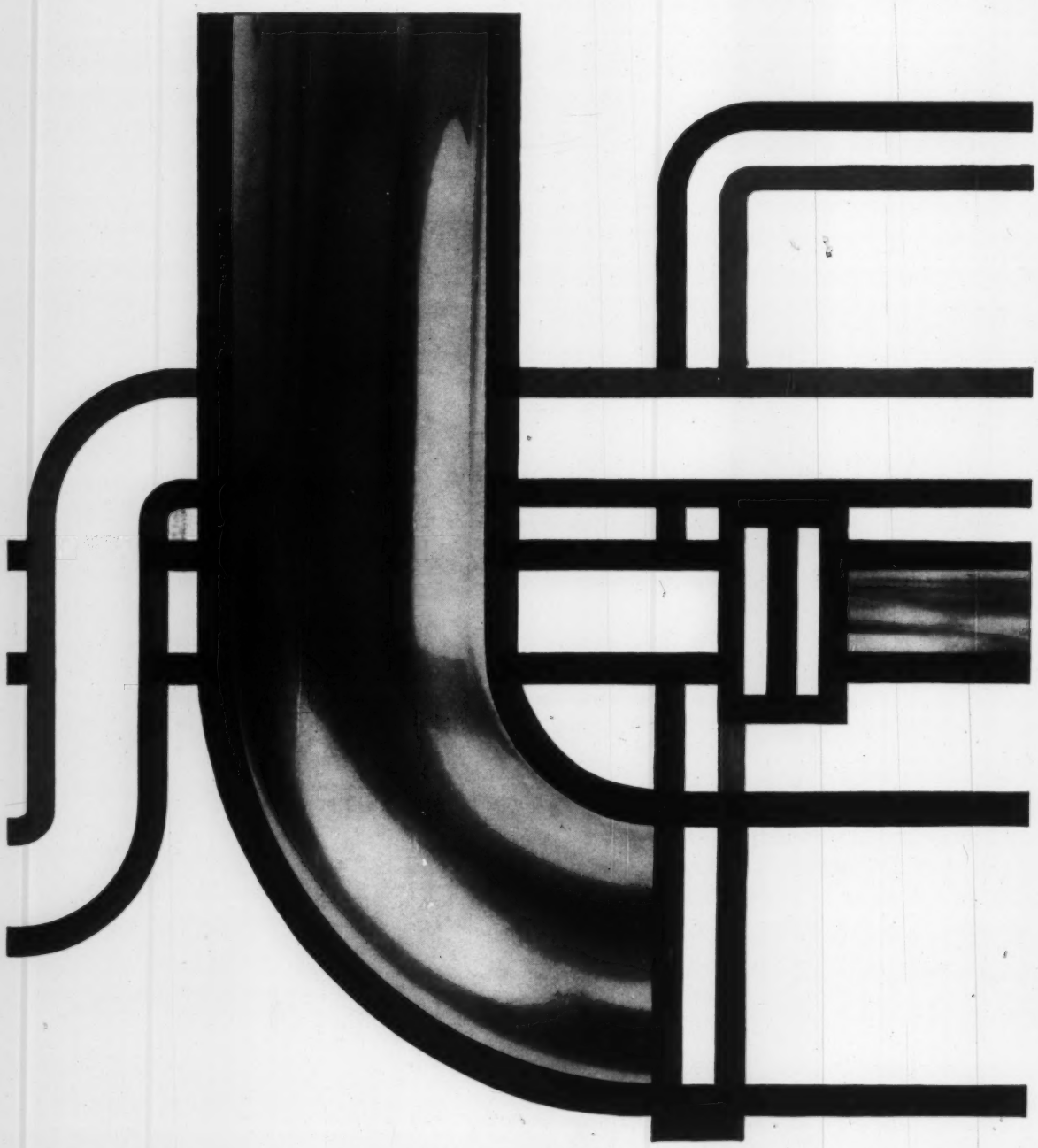
Detailed design data with typical applications, properties and characteristics of GRAPHITAR, are included in Bulletin #20. Write us today—on your letterhead —for a free copy.

R-258-1

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN

GRAPHITAR® CARBON-GRAPHITE • GRAMIX® POWDERED METAL PARTS • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES



win the fight against corrosion—with Alcoa Aluminum

For over 30 years, Alcoa development engineers have successfully employed the outstanding corrosion resistance of aluminum to solve corrosion problems in the process industries. Their unparalleled knowledge of aluminum's behavior in corrosive situations can furnish proved solutions to your most serious corrosion problems. Let Alcoa show you how to *win the fight against corrosion—with Alcoa® Aluminum.* You'll get these extra benefits, too: Light weight • Good workability Low cost • High thermal and electrical conductivity • Great strength in alloys • Non-sparking characteristics • Non-toxicity • Good reflectivity • Clean, attractive appearance.

For immediate help, outline your corrosion problems in a letter to ALUMINUM COMPANY OF AMERICA, 894-M Alcoa Building, Pittsburgh 19, Pennsylvania.

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In the spots that count ... Homestead Valves are

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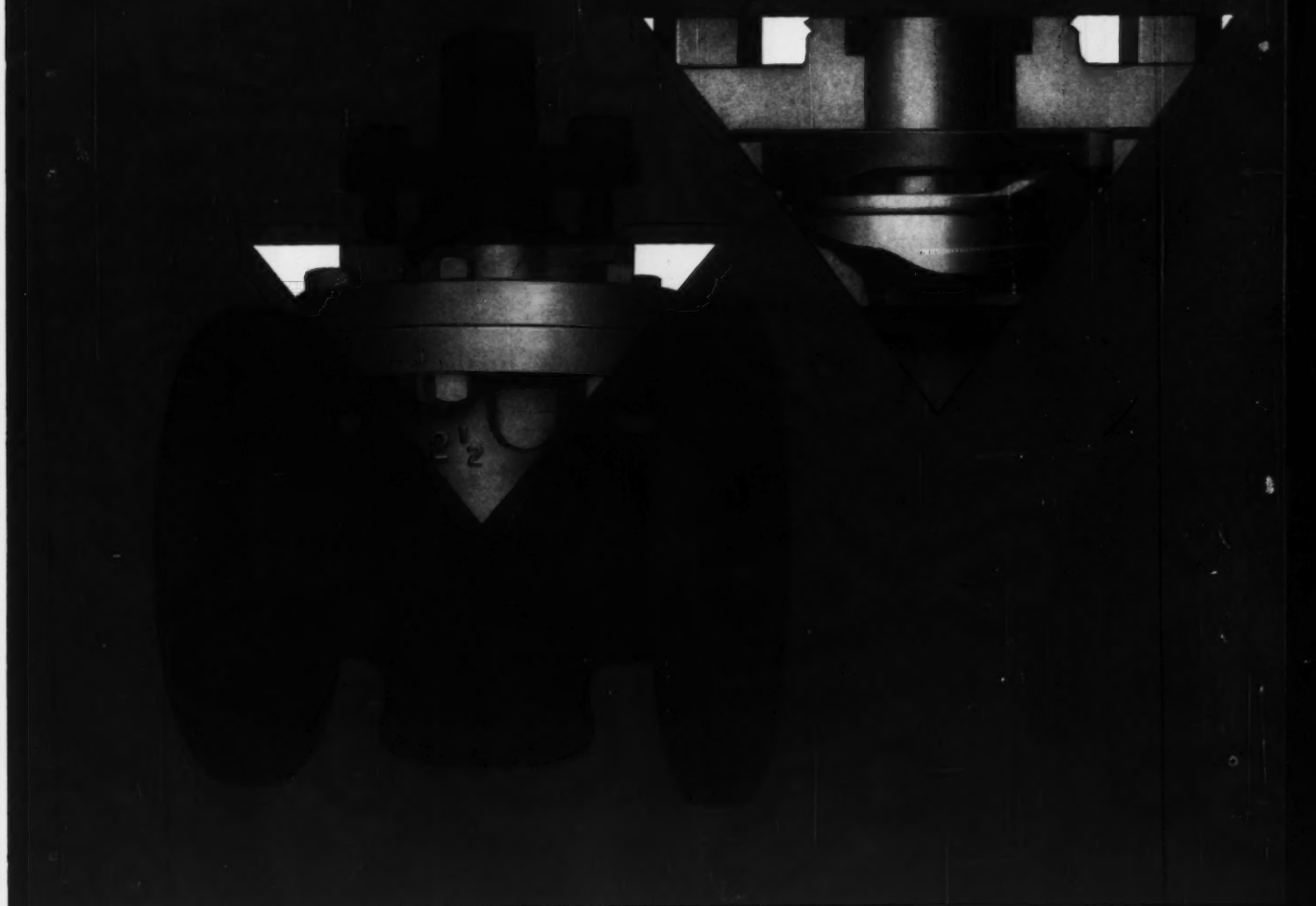

FASTER FLUID CONTROL is guaranteed by the quarter-turn action that fully opens or closes Homestead Cam-Seald Valves. A cam limits plug travel and automatically presses the matched seating surfaces of the plug and body together to form a leakproof, metal-to-metal seal. Additional design features such as the sealed bottom, seal between cap and body, the deep stuffing box, and the fact that fluid or grit cannot pass across the seating surface in the open or closed position, assure long, leak-free service. Write today for complete information—see how Homestead fills your needs.

h
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Attractive — both inside and out — is this newcomer to the Charlotte, North Carolina skyline.

Concrete "curtain walls" give the exterior a distinctive beauty; Clarage Fans give the interior a pleasant atmosphere.

Chosen for the air handling assignment were ten Clarage Type NH system fans and eight Clarage Ready Unit ventilating sets. Prompting this selection: Clarage's recognized ability to perform quietly, economically, *dependably.*

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Kalamazoo, Michigan

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How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

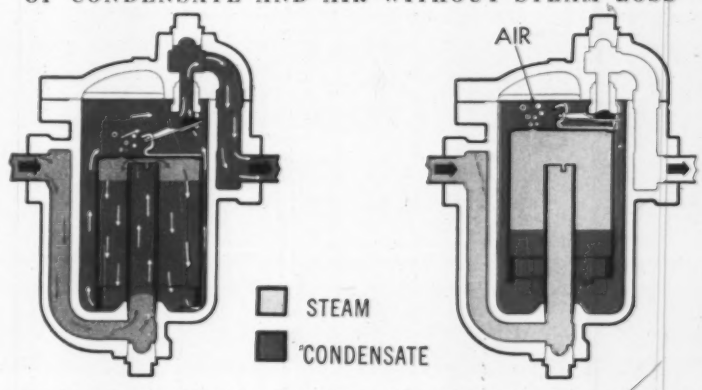
A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

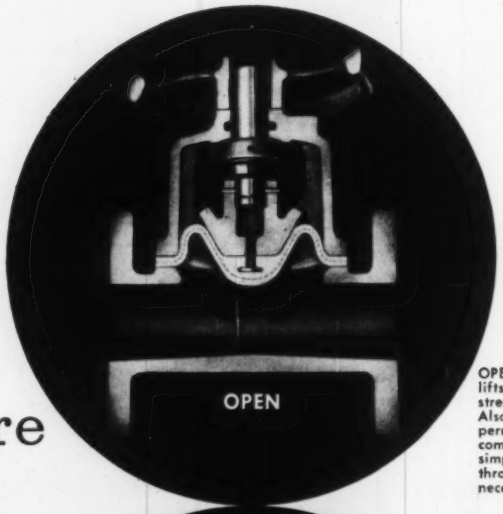
* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

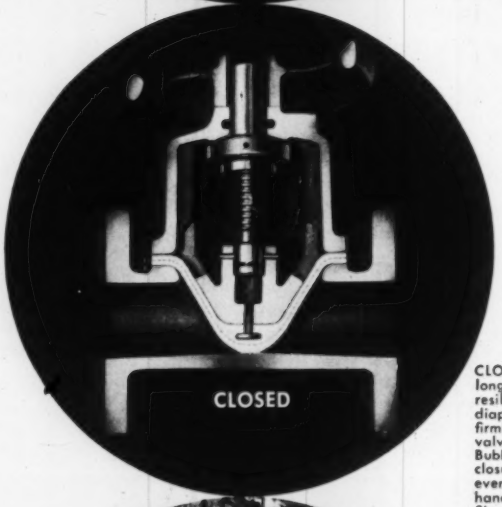
Armstrong Machine Works
8946 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

Maximum flow, minimum turbulence, negligible pressure drop!



OPEN Diaphragm lifts high for streamline flow. Also, valve design permits comparatively simple rodding through, when necessary.



CLOSED Despite long usage, resilient diaphragm seals firmly against valve body. Bubble-tight closure is assured, even when handling gritty or fibrous materials.

GRINNELL-SAUNDERS STRAIGHTWAY DIAPHRAGM VALVES* are unsurpassed for handling viscous materials — semifluid foods, latex, magmas; solids in suspension — slurries, pulp stock, sludges; fluid-borne abrasives; corrosive chemicals.

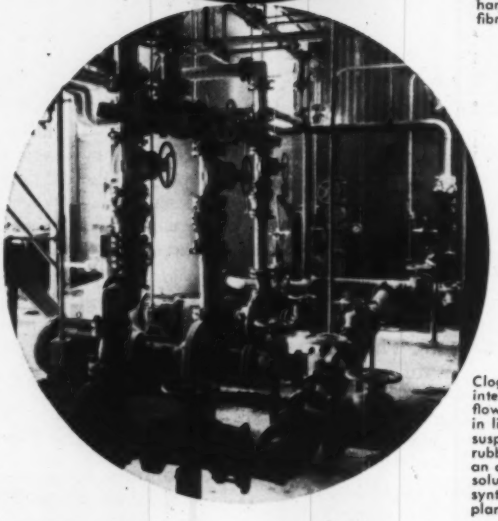
The straight-through design eliminates pockets, gate trenches and other obstructions which can trap solids. The result is maximum flow, minimum turbulence, and negligible pressure drop for a diaphragm valve.

The straight-through design also has the advantage of causing very little basic change in the direction of the fluid stream, thus reducing abrasive action from high velocity particles.

These advantages are in addition, of course, to benefits normally associated with the use of diaphragm valves . . . such as freedom from corrosion and clogging of working parts, since these are completely sealed off by the diaphragm; prevention of product contamination; elimination of stem leakage and routine maintenance, because there are no packing glands. Also, when properly pitched, lines are self-draining.

Grinnell-Saunders Straightway Diaphragm Valves are available in a choice of body sizes and materials, linings and diaphragms. Handwheel or power operated. For complete information, write Grinnell Company, Inc., 277 West Exchange St., Prov. 1, R. I.

*Patented



Clogging and interruption to flow is prevented in lines handling a suspension of rubber particles in an acid brine solution at this synthetic rubber plant.

GRINNELL-SAUNDERS DIAPHRAGM VALVES

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Special reversible, high-speed reduction unit, 8,000 HP, 18,000/1,295.5 RPM.

Special four-speed, in-line, cradle-mounted gear unit, 450 HP, 1,500/3,500 RPM input, ratios 1.20, 1.694, 1.939 and 1.475.

Special right-angle, speed-increasing unit, 600 HP, 2,500/18,922 RPM, with double helical and spiral bevel gears.

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with an individually engineered high-speed unit

Each of the above gear units embodies the solutions to a whole series of problems – presented by the customers' individual requirements, and by the high peripheral speeds involved. Each is a challenge in itself.

That such units can be designed for successful operation is due to (1) Farrel's long experience in meeting "extraordinary" specifications for gear units, and (2) the inherent accuracy of the Farrel-Sykes method of gear generation.

The next time you are in the market for a test-stand unit, call Farrel. In the meantime, send for a copy of bulletin 451.

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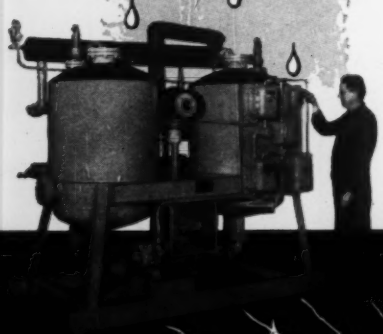
FB-1149

How to get more for your drying dollar

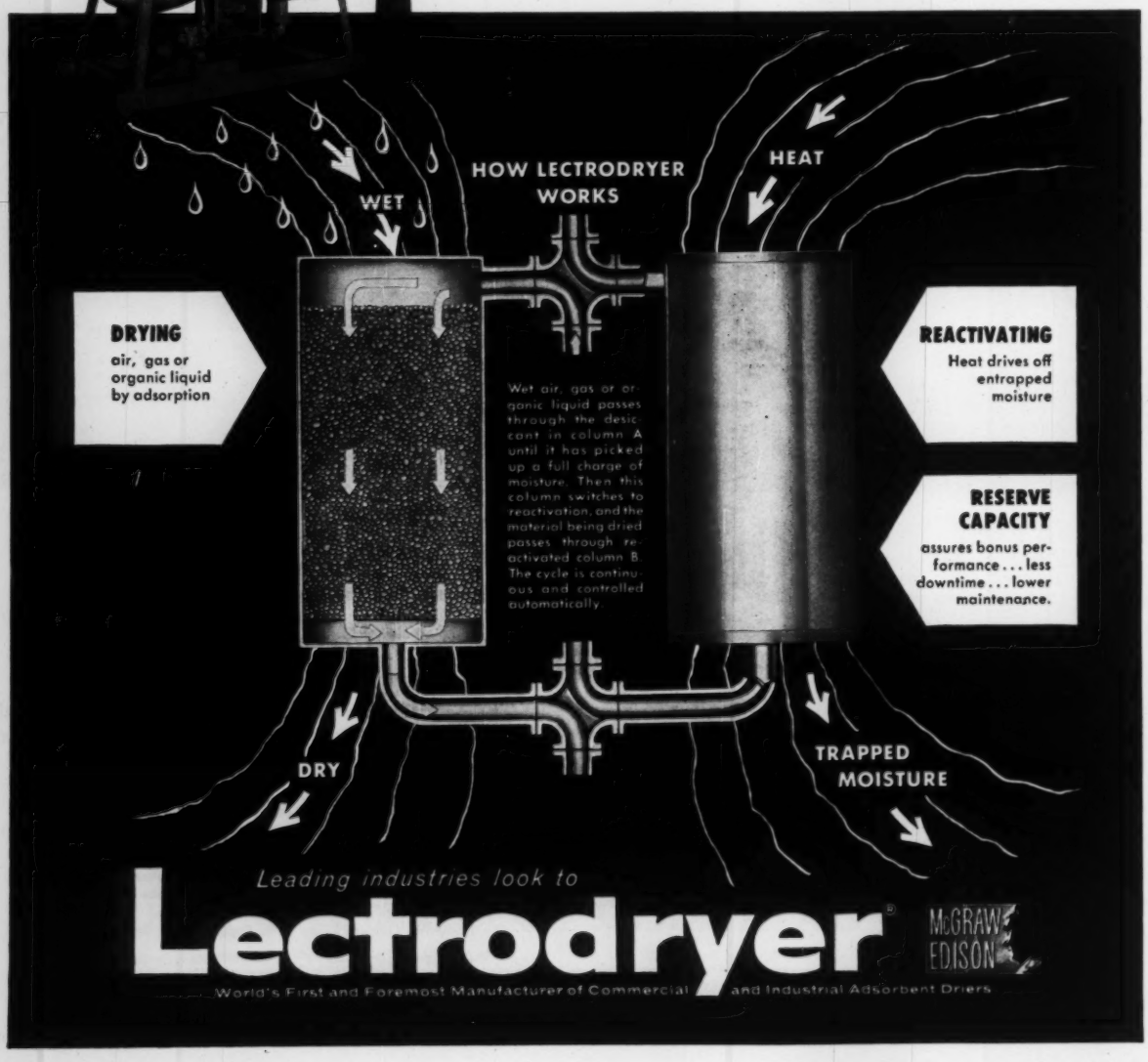


Type BY Lectrodryer for instrument air.

USERS REPORT that Lectrodryer's reserve capacity —in excess of rated output—helps meet normal production growth over the years with no reduction in drying efficiency. The liberal design and rugged construction of Lectrodryers cut downtime and maintenance costs to rock bottom . . . assure sustained, trouble-free, low-cost drying.

Leading industries look to Lectrodryer for better drying because they have found that our high performance standards result in more efficient, more profitable drying operations.

Our engineers will gladly help you solve your drying problems. Write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 335 32nd Street, Pittsburgh 30, Pennsylvania.


HOW LECTRODRYER WORKS
WET
HEAT
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air, gas or organic liquid by adsorption
Wet air, gas or organic liquid passes through the desiccant in column A until it has picked up a full charge of moisture. Then this column switches to reactivation, and the material being dried passes through reactivated column B. The cycle is continuous and controlled automatically.
REACTIVATING
Heat drives off entrapped moisture
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assures bonus performance . . . less downtime . . . lower maintenance.
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Leading industries look to
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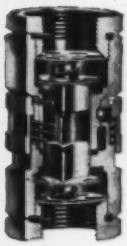
Snap-Tite's "H" Couplings are now factory-stocked for quick shipment to you, not only in the smaller sizes (below 1" ID) but in all sizes up to and including 3"—in steel, brass, aluminum, and 303 and 316 **Stainless Steel.** And "H" Couplings can be made to your order, up to 10" ID.



Available with valves to give two-way or one-way automatic line shut-off, or without valves for straight-thru flow, "H" Couplings are built to handle high pressures in hydraulic and air systems.

Recessed valve washers . . . fluted valve stems . . . valve stops with minimum flow restrictions . . . large inside diameter—allow maximum flow capacity with lowest pressure drop.

See the Snap-Tite representative in your city or write for Bulletin 240.

SNAP-TITE'S "H" COUPLING, SIZE FOR SIZE, IS THE SMALLEST COUPLING WITH HIGHEST STRENGTH AND HIGHER EFFICIENCY

*Snap-Tite, INC.

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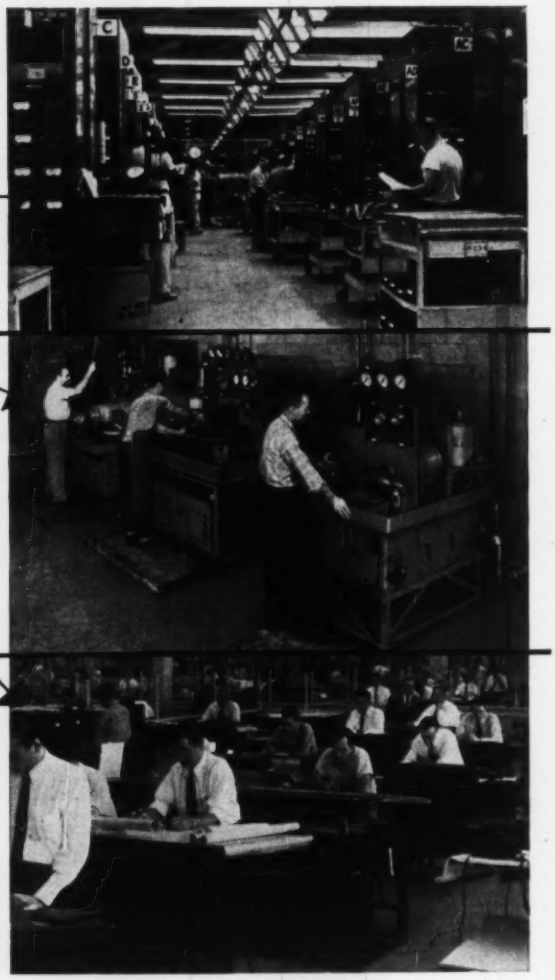

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8154

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

General view of entry end of annealing line.

at Bridgeport Brass Company, Indianapolis, Indiana

Continuous annealing and pickle line with (USS) LORIG-ALIGNER Strip Tracking System increases capacity 12,000 lbs. per hour

THE installation of the Bridgeport Brass continuous annealing and pickle line in August 1957 has increased their strip producing capacity 12,000 lbs. per hour, with a corresponding increase in over-all quality and yield.

"There's over 800 feet of strip in this line," says Plant Engineer R. J. Gardner. "And we have no trouble with strip centering or alignment. The LORIG System has prevented tracking problems."

The LORIG-ALIGNER Strip Tracking System is adaptable to processing lines in both the ferrous and nonferrous metals fields and provides constant control of strip or web alignment. Centering and aligning forces are inherent in the "system" since the specially designed complement of rolls has the ability to maintain strip material on the strip pass-line without the use of complicated exterior sensing and control devices.

For additional information about the LORIG-ALIGNER Strip Tracking System, fill in the coupon.

USS and LORIG-ALIGNER are registered trademarks

The brass strip passes over a Type II LORIG-ALIGNER Roll and under the pinch roll as it enters the line cleaning unit. Shown here are Mr. Fred Ennis, Foreman; Mr. R. J. Gardner, Plant Engineer; and Mr. W. C. Roll, Supervisor of Plant Enginering, Bridgeport Brass Company's Indianapolis plant.

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Export Company

United States Steel

(USS)

United States Steel
Room 2801, 525 William Penn Place
Pittsburgh 30, Pa.
Please send your booklet, "LORIG-ALIGNER Self-Centering ROLLS."

Name_____

Company_____

Address_____

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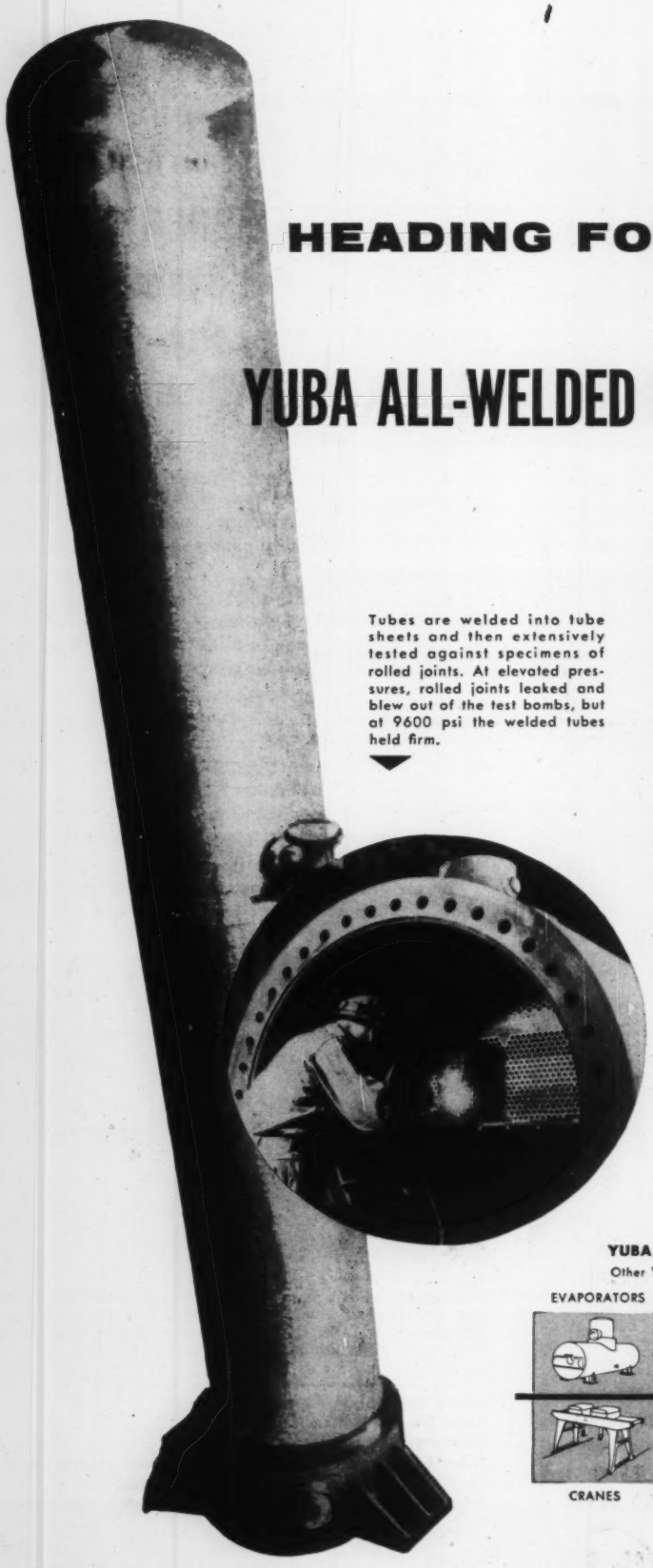
(Please Print)

HEADING FOR 5000 PSI

YUBA ALL-WELDED FEEDWATER HEATERS



Tubes are welded into tube sheets and then extensively tested against specimens of rolled joints. At elevated pressures, rolled joints leaked and blew out of the test bombs, but at 9600 psi the welded tubes held firm.

Twenty-five years ago it was an accomplishment to put 1000 psi into a feedwater heater. Ten years ago, 2500. Today Yuba feedwater heaters are at 4000 psi. Next step — 5000.

A chief reason for the present high pressures and the promise of even higher is Yuba's all-welded Multilok Closure design: tubes welded, not rolled, into tube sheets; shells welded to heads and channels. No flanges or bolting required. In the Multilok Closure, a split key ring in shear absorbs the force resulting from the internal pressure on the cover, and the steel torus ring welded to the channel and to the cover provides the hydraulic seal. Destructive tests on Yuba's well-known Multilok Closure proved the strength of the design of the split key ring construction and the soundness of the torus ring design.

The all-weld design already has set an industry standard and its proved performance has brought orders from the major power companies here and abroad.

Your inquiry is cordially invited.

Power equipment engineered and manufactured by
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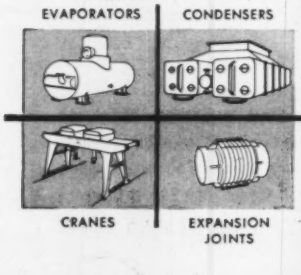
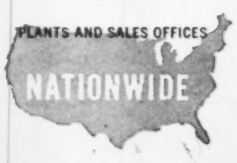
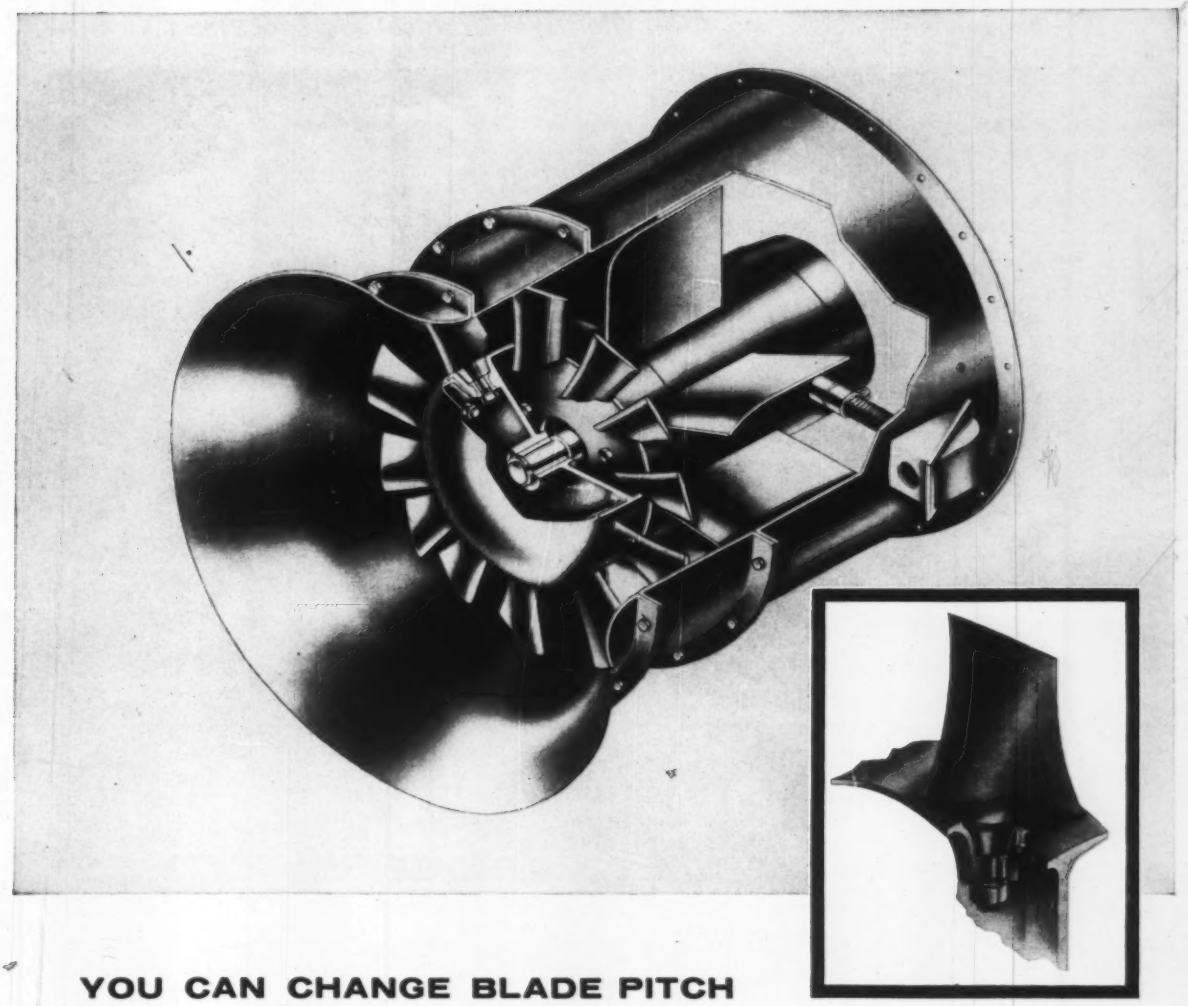
YUBA MANUFACTURING DIVISION
Benicia, Calif.

YUBA CONSOLIDATED INDUSTRIES, INC.
Other Yuba products for the Power Industry



YUBA





YOU CAN CHANGE BLADE PITCH TO CHANGE VOLUME AND PRESSURE WITH

JOY AXIVANE FANS

If calculated and operational requirements differ . . . if system characteristics change . . . or if resistance is difficult to predict —Joy fans can solve your problem. The blade pitch is adjustable. The factory blade-setting can be changed quickly to provide either a wide pressure-range for any particular volume or a change in volume. The inset photograph shows how this can be done using only a common wrench.

Other advantages: The motor is inside the fan . . . no drive losses. This makes the fan unusually compact and efficient . . . easy to mount. There are *1600 standard models* in all combinations of horsepower, pressures, and volumes. Also available with V-belt drives. Send in the coupon now for complete information.

Joy Manufacturing Company, Oliver Building, Pittsburgh, Pa. In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.

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JOY SAVES YOU MONEY ON AIR

Joy Manufacturing Company
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company

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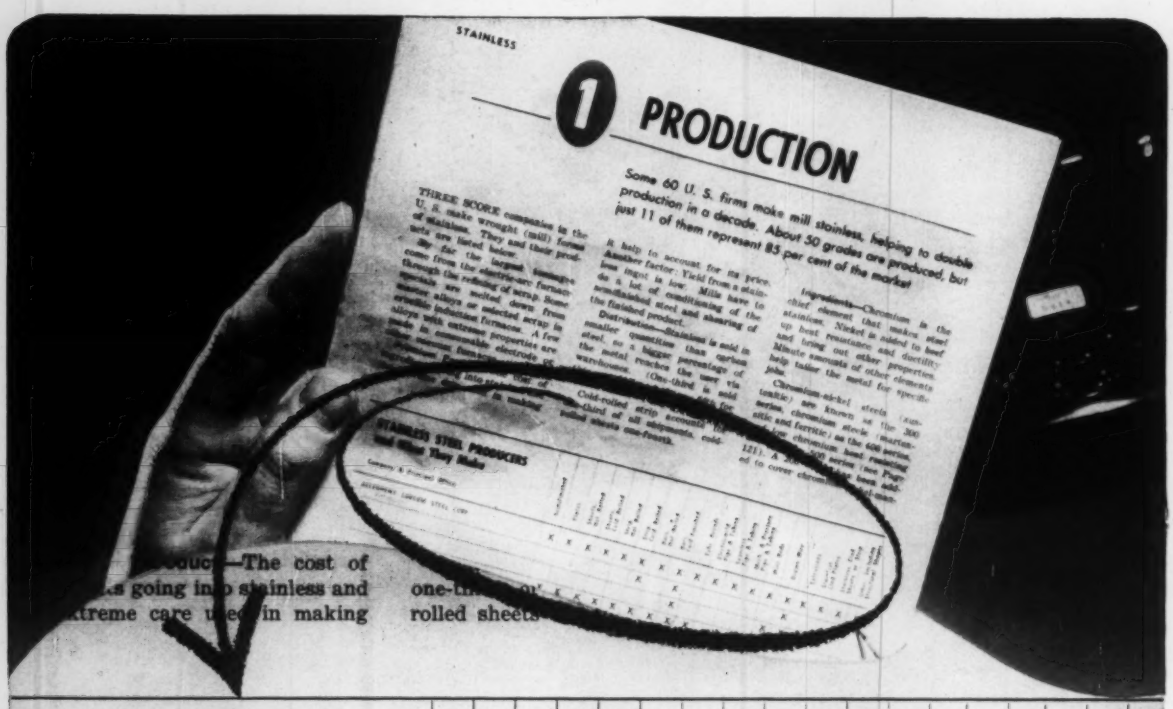
I am interested in Joy Axivane Fan information on:

Experience**—the added alloy in **A-L Stainless, Electrical and Tool Steels


STAINLESS
1 PRODUCTION
Some 60 U. S. firms make mill stainless, helping to double production in a decade. About 50 grades are produced, but just 11 of them represent 85 per cent of the market
THREE SCORE companies in the U. S. make wrought (mill) forms of stainless. They and their products are listed below.
STAINLESS STEEL PRODUCERS and What They Make

STAINLESS STEEL PRODUCERS and What They Make Company & Principal Office	Semifinished	Plates	Sheets, Hot Rolled	Sheets, Cold Rolled	Strip, Hot Rolled	Strip, Cold Rolled	Bars, Hot Rolled	Bars, Cold Finished	Tube Rounds	Electricweld Pipe & Tubing	Seamless Pipe & Tubing	Mech. & Pressure Pipe & Tubing	Wire Rods	Drawn Wire	Extrusions	Stainless Clad Plates	Stainless Clad Sheets or Strip	Other, Including Structural Shapes
ALLEGHENY LUDLUM STEEL CORP. Pittsburgh	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
[illegible]						X		X						X				

Of the 60 producers of stainless steel...

only ALLEGHENY LUDLUM makes all sizes, shapes, finishes and analyses

In its November 4, 1957 issue, STEEL magazine published a complete run-down on the stainless steel industry. This article reveals that *only Allegheny Ludlum*, of the 60 some companies making stainless, produces all sizes, shapes, finishes and analyses.

This can save you considerable time and money. When you make Allegheny Ludlum your *one* source of stainless, you work with *one* sales engineer—*one* order, whether you buy sheet, strip, bars, tubing or whatever.

And, at the same time, you get the best technical service. A-L's crack research and development department is continually searching for new alloys, and better ways to use today's. Its findings are freely available to you through sales engineers, technicians and special literature.

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Walkway to efficient dust control

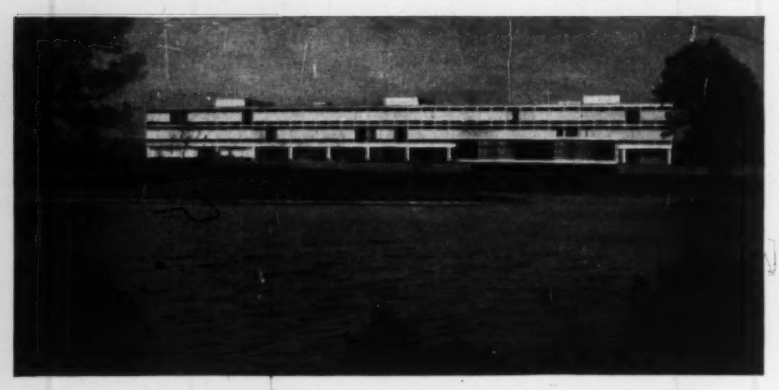
Pangborn Cloth Bag Dust Collector on the job. This is just one of Pangborn's complete line of wet and dry dust collectors.

See those bags? They're the *collect* in the Pangborn Cloth Bag Dust Collector. And they're efficient! The cloth filter has proved the most practical method for collecting finely divided dry dusts. But Pangborn goes a step further. Pangborn engineering has not only adapted this design to increase its collecting effectiveness but has simplified its construction. This means you save money. The Pangborn Cloth Bag Collector offers maximum efficiency, yet is economical to buy, install and operate.

Pangborn engineering is important to every dust-producing plant, regardless of the kind of collector needed. It is not enough to put a dust collector within a plant. An efficient dust collecting system must be *scientifically* planned, designed and constructed to handle effectively a specific dust problem. This thinking is incorporated into every Pangborn proposal.

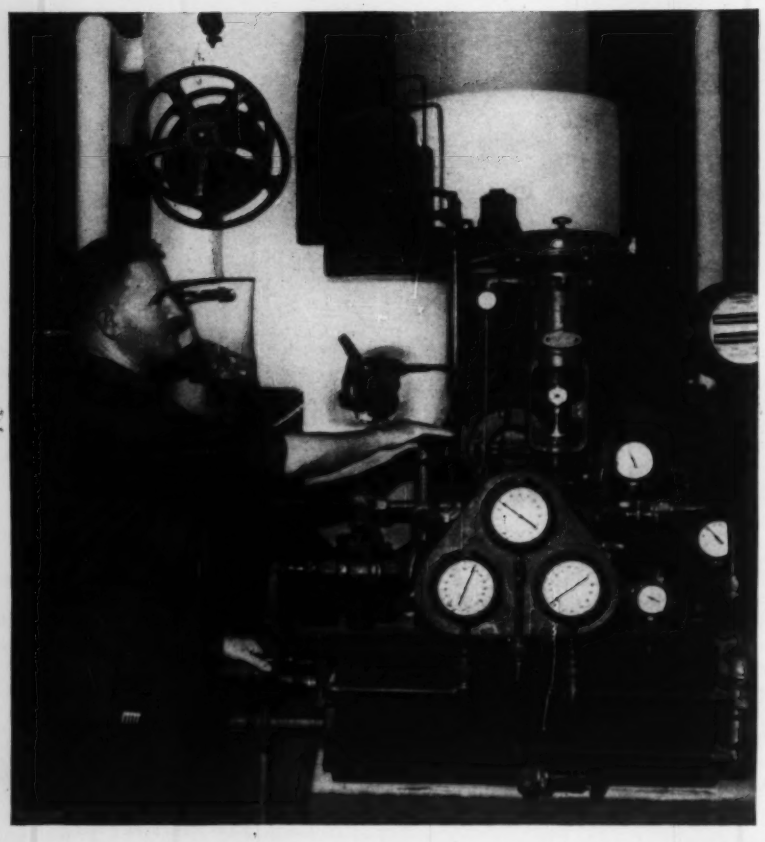
The Pangborn Engineer in your area will be glad to go to work for you. He is a dust expert *and will discuss your individual problem at no obligation. And, for more information, write for Bulletin 922 to:* Pangborn Corp., *2200 Pangborn Blvd., Hagerstown, Md. Manufacturers of Dust Control and Blast Cleaning Equipment.*

Pangborn CONTROLS DUST



New home office for Connecticut General Life is a modern structure five miles out in the country.

Terry turbines power air-conditioning system at new Connecticut General Life building



One of two 870-hp, 3970-rpm Terry turbines built to drive the refrigeration compressors.

The new home office of the Connecticut General Life Insurance Co., in suburban Hartford, represents the best in contemporary architecture as well as construction techniques and materials.

In keeping with the careful planning evident throughout the project, two Terry turbines were selected to drive the York centrifugal refrigeration compressors. Terry turbines such as these have a record of low maintenance and consistent reliability under varied conditions. The steam generators, which are used for general heating during the winter months, furnish the power to operate the turbines. This provides an economical and dependable air-conditioning setup.

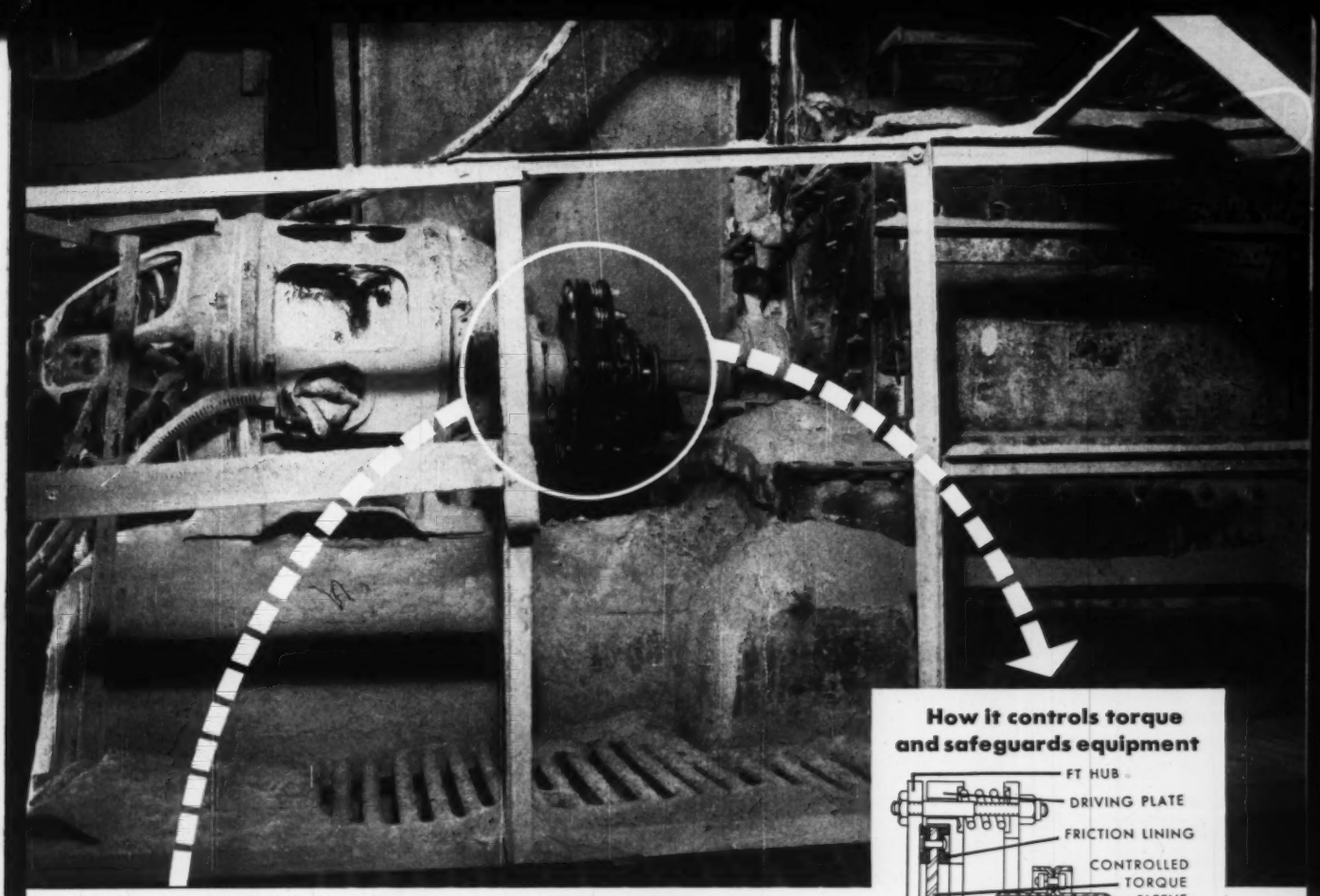
The steel and glass building accommodating 2500 employees overlooks New England farmland. It is furnished with modern equipment, to step up the efficiency of clerical work. Other amenities: lounges, game rooms, cafeteria, bowling alleys, barber and beauty shops, variety store, medical department.

If you are planning an air-conditioning system, perhaps you, too, should consider steam-turbine drive. Write for detailed information about the advantages of turbines for your specific requirements.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1213



Protect machines from overload damage with FALK Controlled Torque Couplings

The above picture shows a Falk Controlled Torque Coupling connecting a 150 hp motor to a hammermill. Formerly, when tramp iron got into the mill, it was necessary to rewind the motor at least twice a year. But, in the 2½ years after installing a Falk Controlled Torque Coupling, no motor repairs were required. *That is real saving!*

Wherever overload danger exists, a Falk Controlled Torque Coupling gives positive protection against machinery damage from excessive torque or jams. This unique coupling has an adjustable friction slip clutch which can be set at *any* predetermined torque limit. Thus, transmission of dangerous shocks is prevented...overloads are limited...shaft breakage is eliminated.

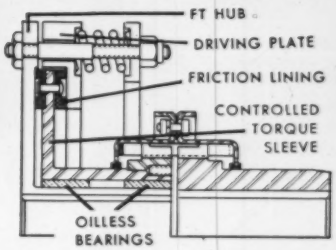
Another big advantage is that, when the cause of the overload is removed, the entire coupling will rotate and transmit power without resetting, and *without replacing parts or repairing the coupling*....And, the Controlled Torque Coupling incorporates the famous Falk Steelflex torsional resilience to smother ordinary shock and vibration, plus the ability to accommodate shaft misalignment....Consult your Falk Representative or Authorized Falk Distributor. **Ask for Bulletin 4100.**

THE FALK CORPORATION, MILWAUKEE 1, WISCONSIN

MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS

Representatives and Distributors in many principal cities.

How it controls torque and safeguards equipment



Here (as in photo), the torque-control hub is shown mounted on driving shaft. From this hub, power is transmitted through friction lining to controlled torque sleeve. Load to be transmitted is determined by the (pre-set) pressure on friction lining. In case of overload, this hub still rotates until power is shut off—but the rest of the coupling and the driven machine will slow down or stop.

Motor Shut-off Control

By adding an automatic cut-out switch with V-belt connection to driven shaft, motor can be stopped immediately. With the standard hub mounted on driven shaft, the switch opens the electric circuit when speed of switch falls below predetermined value.

FALK

...a good name in industry

POWELL

world's largest family of valves

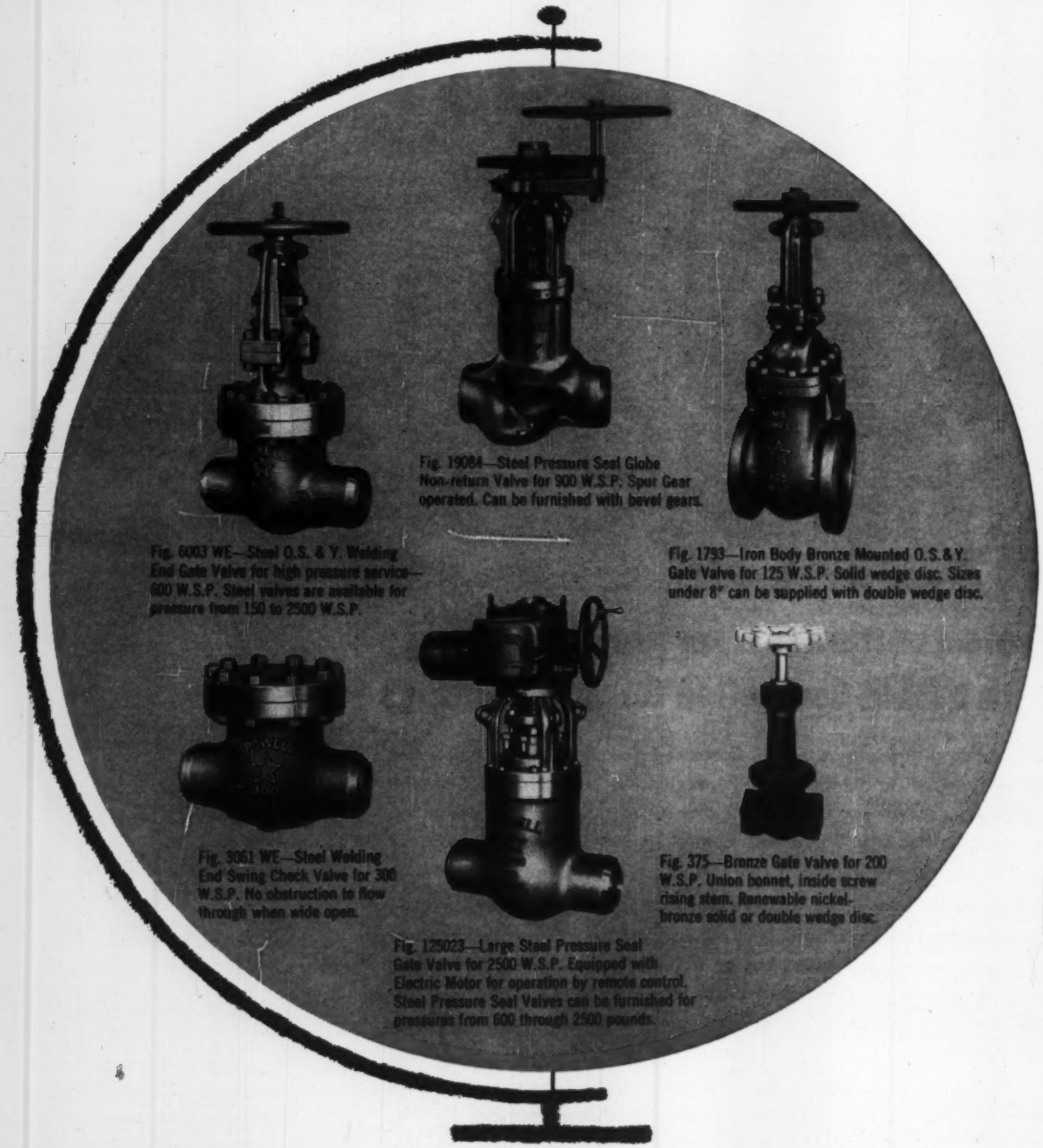
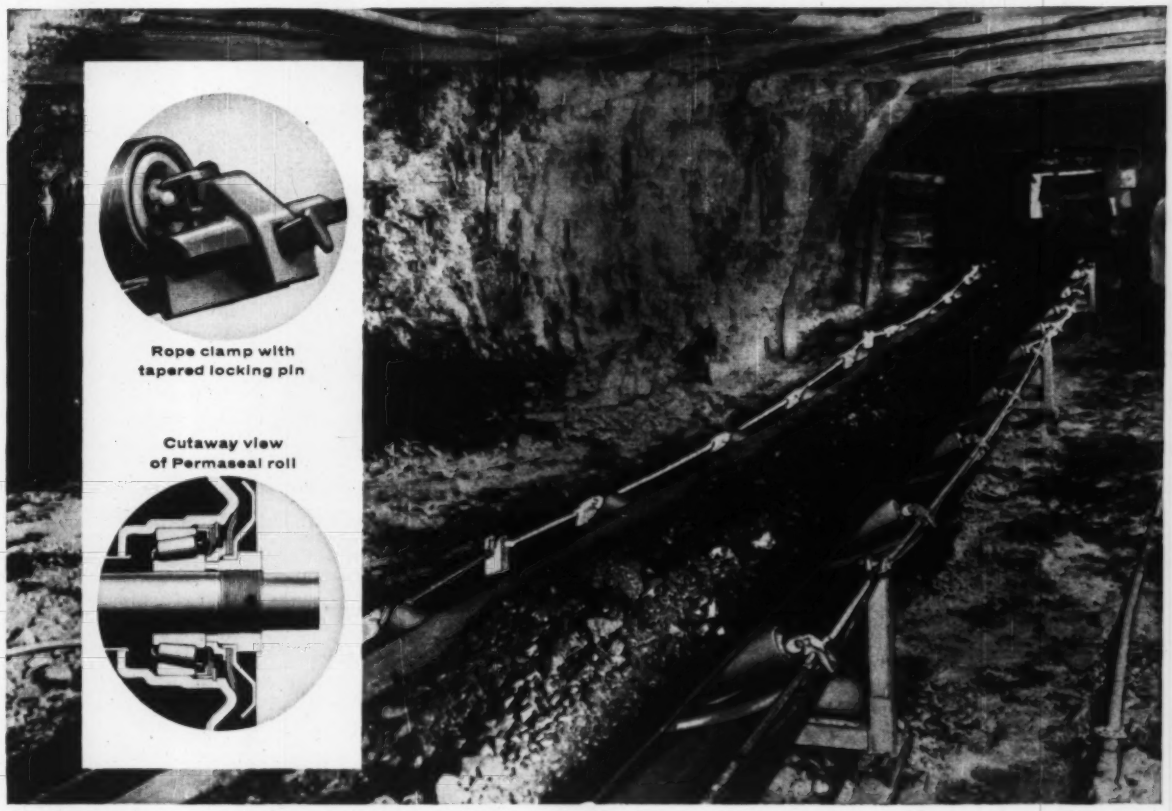


Fig. 19084—Steel Pressure Seal Globe Non-return Valve for 900 W.S.P. Spur Gear operated. Can be furnished with bevel gears.
Fig. 6003 WE—Steel O.S. & Y. Welding End Gate Valve for high pressure service—600 W.S.P. Steel valves are available for pressure from 150 to 2500 W.S.P.
Fig. 1793—Iron Body Bronze Mounted O.S. & Y. Gate Valve for 125 W.S.P. Solid wedge disc. Sizes under 8" can be supplied with double wedge disc.
Fig. 3061 WE—Steel Welding End Swing Check Valve for 300 W.S.P. No obstruction to flow through when wide open.
Fig. 375—Bronze Gate Valve for 200 W.S.P. Union bonnet, inside screw rising stem. Renewable nickel-bronze solid or double wedge disc.
Fig. 125023—Large Steel Pressure Seal Gate Valve for 2500 W.S.P. Equipped with Electric Motor for operation by remote control. Steel Pressure Seal Valves can be furnished for pressures from 600 through 2500 pounds.

FOR EVERY FLOW CONTROL PROBLEM Powell offers more kinds or types of valves, available in the largest variety of metals and alloys, to handle every flow control requirement. Your local valve distributor will be glad to tell you all about them. Or write to us for the full facts.

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**



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(wire rope type)

have these advantages . . .

Low first cost—Easy and economical to set up with fewer parts; need no belt training idlers; intermediate sections require no cover plates; two parallel wire ropes replace heavy rigid type angles or channel side frames.

Low operating costs—Fewer components to handle or transport saves time in extending or retracting. Little or no spillage means less clean-up time.

Long belt life—Lasts longer as load impact is absorbed by spring effect of wire ropes when load passes over troughing idlers.

Permaseal idlers—Have Timken tapered roller bearings protected by two flexible diaphragm seals. Inner seal retains lubricant. Outer seal keeps out dirt. Prelubricated for years of maintenance-free service.

Spacing of idlers—Can be changed easily to suit material or mine conditions.

Rope clamp for cradle bracket—Rope clamps with "no loss" tapered locking pins prevent creeping. Cradle brackets and support stands hold ropes parallel. No separate spreader required.

Versatility—These conveyors can be used above or below ground to handle coal, salt, gypsum, iron ore, etc.

For more details send for bulletin 948. The Jeffrey Manufacturing Company, 915 North Fourth Street, Columbus 16, Ohio.

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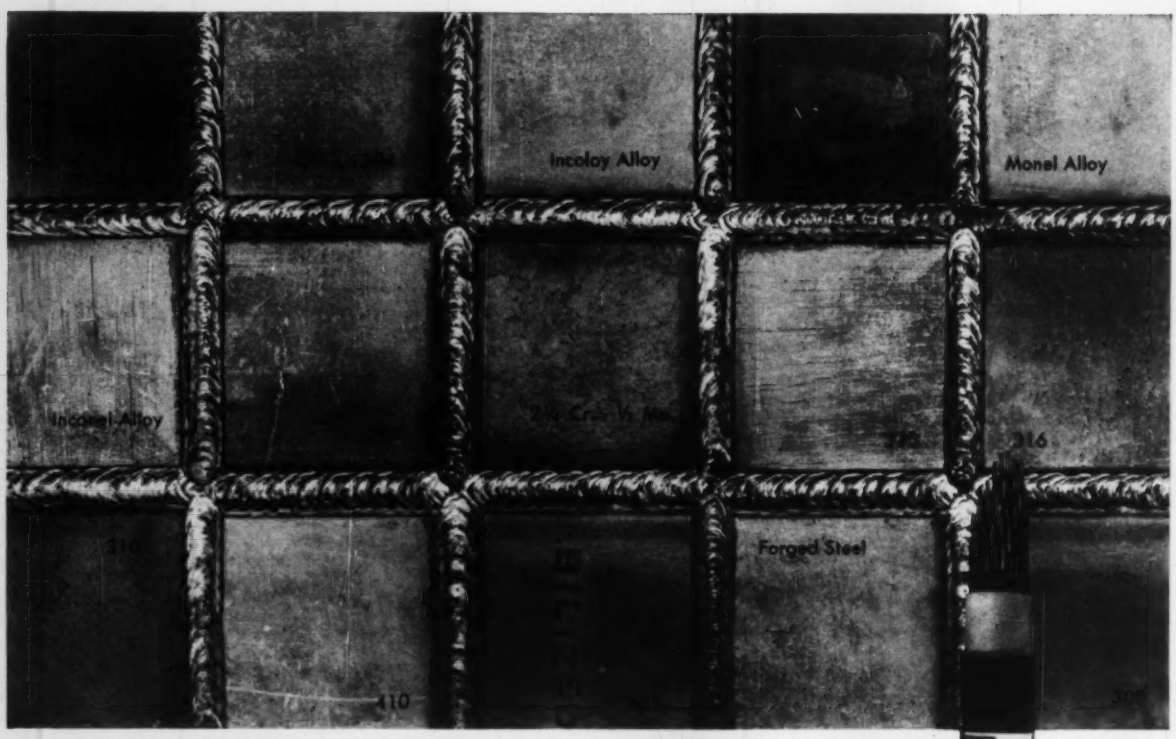
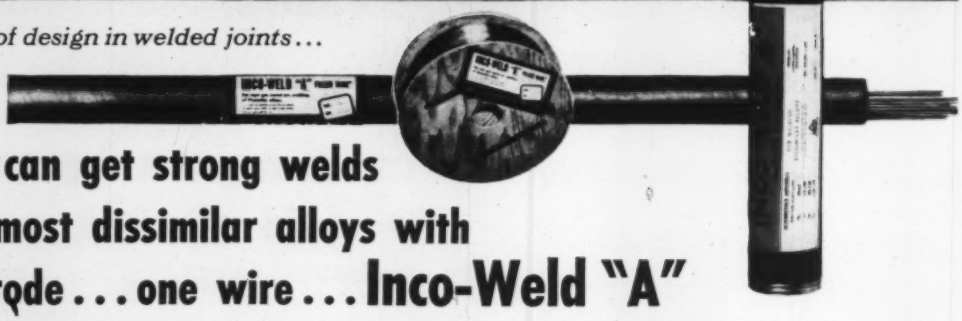
MINING • CONVEYING • PROCESSING EQUIPMENT...TRANSMISSION MACHINERY...CONTRACT MANUFACTURING



New freedom of design in welded joints...



Now you can get strong welds between most dissimilar alloys with one electrode... one wire... Inco-Weld "A"

No longer do you need to avoid designs involving welded joints between dissimilar alloys.

With Inco-Weld* "A" Electrode or Inco-Weld "A" Wire you can rely on sound production welds in better than 97% of dissimilar alloy combinations involving ferritic and austenitic stainless steels, low alloy steels, mild steels, high nickel alloys and other alloys.

Inco-Weld "A" Electrode and Wire assure you of strong, ductile joints suitable for severe service . . . welds of X-ray quality . . . made without special training or techniques.

Corrosion resistance of joints usually equals or exceeds that of the base metal. With Inco-Weld "A" Wire, the deposit can be age-hardened.

Don't hesitate to design in dissimilar alloys . . . keep Inco-Weld "A" versatility in mind.

For technical data and case history evidence showing how others use Inco-Weld "A" Electrode and Wire successfully, send for folder "Now You Can Weld Dissimilar Alloys." Write The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

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SOME OTHER DISSIMILAR METALS SUCCESSFULLY WELDED WITH INCO-WELD "A" WIRE

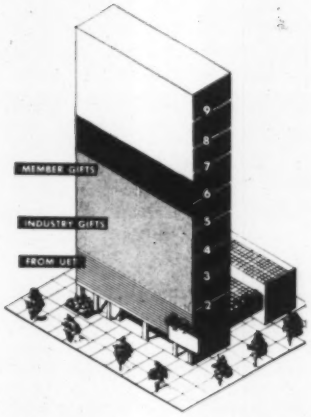
Plate Material	Thickness	Plate Material	Thickness
304 to Monel Alloy	.078"	Nickel to SA-285	.062"
304 to Carbon Steel	.078"	Inconel Alloy to Hastelloy "C" Alloy	.078"
Carbon Steel to Monel Alloy	.078"	10% Ni-Clad-Steel to 10% Ni-Clad-Steel	¼"
Carbon Steel to Inconel Alloy	⅜"	3½% Ni-Steel to 3½% Ni-Steel	½"

INCO WELDING PRODUCTS

electrodes · wires · fluxes

MECHANICAL ENGINEERING

VOLUME 80 • NUMBER 12 • DECEMBER, 1958



Going Up?

Twice before, and each time successfully, ASME has appealed to its members to finance purchase of its headquarters. In 1890 the Society's first home, at 12 West 31st Street, New York City, was purchased with funds subscribed by the members, and in the early 1900's, ASME members again came to the aid of their Society by subscribing the ASME share of the purchase price of the land on West 39th Street on which Andrew Carnegie erected the present, but now outgrown, Engineering Societies Building.

Today the engineers of this generation are being asked to contribute to the new United Engineering Center—symbol of the unity of the profession.

Surely every member will wish to contribute, even if only a trifle, as a token of his appreciation of what the engineering profession means to him as a way of life and a livelihood. Each of us has by now a pledge card. If you have not already done so, fill out yours today.

No more revealing survey of the engineering profession will ever be made than the final percentages and amounts of individual gifts to the present building fund. If individual engineers do not feel strongly enough about the status and progress of their profession to give full and complete support to the Building Fund, they can scarcely expect laymen, employers, the government, or the world in general to recognize them as members of a great profession.

The foregoing neatly sums up the job that needs to be done—and by whom—if a center for the engineering profession is ever to be realized. But somewhere along the line the Member Gifts Campaign has stumbled and stubbed its toe. Result: As of November 7, member gifts totaled only $1,012,852 of the $3 million allocated from the individual members of the Founder Societies. This amounts to only 33.7 per cent of the quota.

Even more discouraging is the fact that only 3133 out of 45,000 ASME members have pledged $202,374 of their $800,000 quota, or 25.3 per cent. Percentagewise, ASME is running fourth out of the five Founder Societies in dollars pledged. (For additional facts and figures on the United Engineering Center, see pages 120–122 in this issue.)

The ASME Member Gifts Campaign must get into high gear now if it is to reach its goal of $800,000.

While the foregoing paints a dark picture, there is a bright side to the United Engineering Center Building Fund: The Industry Campaign. As of November 7, gifts totaled $3,748,583 of the $5 million allocated from business and industry, or roughly 75 per cent. If industry, with its hard-thinking, realistic businessmen, contributes toward this proposed engineering center, surely each member, as a man with pride in his profession, will want to do his part.

Recapitulating the ASME Member Gifts Campaign: The goal—$800,000; pledged thus far—$202,374; per cent of quota pledged—25.3 per cent; number of ASME subscribers—3133; not pledged—$597,626; per cent of quota not pledged—74.7 per cent; number of ASME nonsubscribers—41,867.

To the 3133 ASME members who have already subscribed: Congratulations on making a sound investment. To the 41,867 ASME members who have not as yet invested: Now is the time to make your pledge.

This is the challenge! Will ASME members once again meet it?

J. J. Jaklitsch, Jr.

Editor, J. J. JAKLITSCH, JR.

Editor Emeritus, GEORGE A. STETSON

They spend one day in five doing clerical work. As to basic research, maybe they do more than management thinks. There are areas that want investigating.

How Do Research Scientists Spend Their Time?

By George A. Peters[1] and Max Lees[2]

With the increasing size and importance of research and development organizations, greater attention is being paid to finding improved techniques for efficient research management. One major problem is to find out how research scientists actually spend their time and to determine how this relates to company objectives and the needs and desires of the scientists themselves.

Procedure

To gain some objective information on this subject, it was decided to go directly to the research scientist himself and secure responses which would be unbiased by management expectations. It was also decided that the information should be based upon a thorough sampling from one large company checked against a second sample drawn from a cross section of industrial research organizations. Thus a confidential questionnaire was designed and submitted to two different groups of research scientists. Group A consisted of 102 research scientists selected by random-sampling techniques from a large research and development organization. This *homogeneous* sample constituted approximately one third of the available nonsupervisory scientists and technicians in the organization. Group B consisted of 70 research scientists who were employed in a wide variety of industrial organizations and were taking graduate-level evening courses at Stevens Institute of Technology. It was felt that this group constituted a *heterogeneous* sample because the respondents represented a cross section of industrial research organizations. The results obtained from each sample were sufficiently alike to suggest a general trend which may be characteristic of the feelings and opinions of research scientists in general.

Results and Discussion

These research scientists felt that from 20 to 22 per cent of their time is actually spent doing routine clerical or administrative tasks which could be performed by someone else. This is important in that these were nonsupervisory employees who could be expected to have a minimum of administrative chores. This amounts to over one day of each work week which is lost from the higher level professional work for which the individual was employed. The majority of these employees (71.6 per cent of Group A and 60.3 per cent of Group B) also felt that the time which is spent on routine administrative tasks should be decreased or largely eliminated. This is of particular significance since the nature of creative research work requires the scientist to become completely engrossed in a problem, and any interruption of his concentration by administrative chores could be extremely wasteful and expensive.

Although almost one fifth of the time of these research scientists is apparently spent doing basic or fundamental research, the majority seem to feel that it should be increased. In Group A 60.4 per cent, and in Group B 64.5 per cent, of the scientists felt the time spent on basic or fundamental research could most profitably be increased. Since there is considerable discussion in the scientific literature concerning the importance of basic or fundamental research, and since the scientific leadership essential for the success of any research and development laboratory is demonstrated by the publication of such studies, management must be receptive to such ideals despite the realities and necessities for an applied or developmental emphasis.

A further analysis of Group A indicated that the sample was composed mainly of those in the applied sciences (engineering sciences 53.8 per cent) rather than those sciences where a greater emphasis on basic research might be expected (physical sciences 36.6 per cent, other disciplines 9.7 per cent). There is no essential difference between the responses of those in the engineering sciences as compared to those in the physical sciences (see Table 2).

These results apparently came as a surprise to some of the research managers directly concerned since they expressed the opinions that their employees "couldn't be doing that much basic research" and that "they probably don't know what basic research actually is." Of course, the dividing line between developmental and basic research is none too clear. But, since the definitions used in this study were supplied to the research

[1] Consultant, Psychological Research Associates, Inc., Encino, Calif.

[2] Mechanical Engineer, Natal, South Africa.

Contributed by the Management Division and presented at the Semi-Annual Meeting, Detroit, Mich., June 15–19, 1958, of The American Society of Mechanical Engineers. Paper No. 58—SA-37.

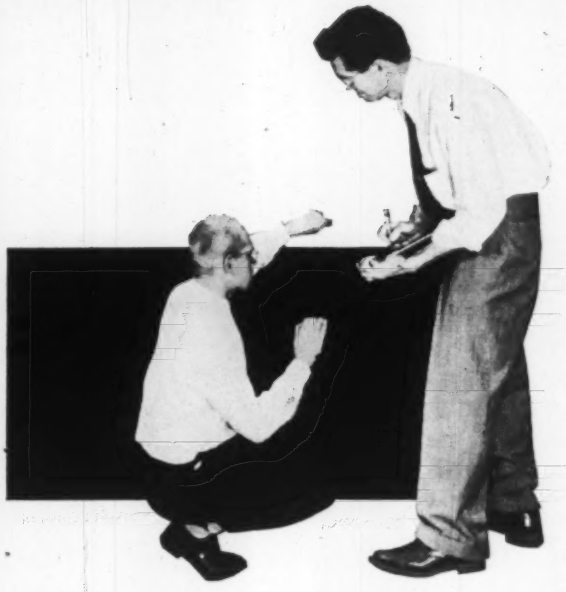


Table 1 Distribution of Research Scientists' Time

Approximate percentage of time actually spent during the past few months on:

	Group A, per cent	Group B, per cent
Fundamental research (Work having little or nothing to do with the company's business)	2.6	2.9
Basic research (Search for new knowledge related directly to the company's business)	17.4	15.0
Applied research (Application of available research information to company problems or product development)	47.8	54.2
Administrative tasks (Routine clerical or administrative tasks *which could be performed by someone else*)	22.1	20.1
Other work	10.1	7.7

Note: Except for the percentages, this was the actual form of the questionnaire.

scientists examined, such remarks probably indicate that those in management have a different view or perspective of the nature of the work accomplished than do those in the lower echelons. Either those in management are underestimating the type of work done or, conversely, the research scientists are attempting to gain professional status by claiming to engage in more basic research activities than is truly the case.

Some profit-making concerns have announced intentions to encourage their scientific personnel to spend a much larger proportion of their time on basic and fundamental research. This has achieved widespread favorable comment. Thus the atmosphere is such that management must not appear as a barrier toward more basic research.

If a research scientist perceives that it is too difficult to achieve personal recognition in the company for which he works, he may look to his own professional group for some personal recognition or ego enhancement. This may be accomplished by activities such as basic or fundamental research which are more profession-oriented than company-oriented. This indicates that management may have failed to provide sufficient opportunities for status recognition as a reward for individual accomplishment. Of course, there are insufficient promotional opportunities in any organizational structure for all who achieve outstanding accomplishments. What may be needed is more individual recognition through local or national publicity, opportunities for work of greater professional challenge, publication opportunities in professional journals, a liberal policy on copyrights and patents, greater latitude in decisions regarding the parameters of future research investigations, and other recognition of the personal worth, significant achievement, and importance of the individual to the company. Negative attitudes are usually accentuated where there is a failure of management to meet the expectations of the individual research scientist. Such negative motivational influences are not conducive to productive effort and, if widespread, may indicate a need for management self-appraisal.

If the majority of research scientists feel that one day out of five is not enough and that more time could be profitably spent on basic or fundamental research, then it is only good management practice to carefully investigate the merits of such a procedure. Perhaps, with an adequate incentive system and means of granting recognition for significant accomplishment, such an increased investment in the potentialities of basic and fundamental research would yield a surprising return. But, before proceeding with such a step, the attitudes and motivations of the scientists should be carefully assessed to insure that the working environment is truly receptive and capable of responding to the challenge.

Conclusions

The research scientists sampled in this study:

1 Lose one day out of each work week doing routine clerical or administrative tasks which they feel could be performed by someone else. The majority of these research scientists feel that this time should be decreased or largely eliminated.

2 Believe that they spend approximately one day out of each work week doing basic or fundamental research. The majority of these research scientists feel that this time could, most profitably, be increased.

It is recommended that research managers:

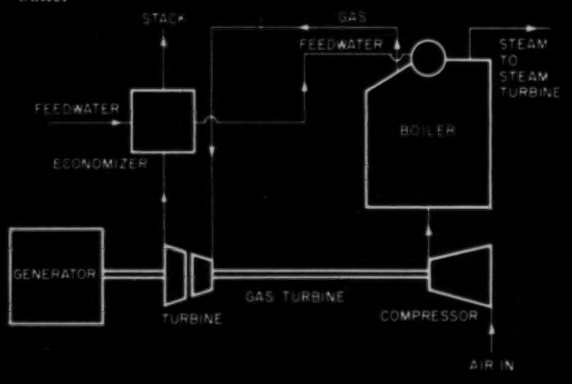
1 Should attempt to reduce any unnecessary administrative burden placed upon professional scientists by providing adequate clerical and administrative assistance.

2 Investigate the possibility of increasing the proportion of time devoted to basic and fundamental research among all their scientific personnel. In such a decision management has to clearly distinguish between negative feelings toward management and the legitimate desire for increased research responsibility. An essential prerequisite of the success of such a plan is some means of providing ample individual recognition for research accomplishments.

Table 2 Distribution of Time

	Physical sciences, per cent	Engineering sciences, per cent
Fundamental research	3.8	2.2
Basic research	15.4	15.9
Applied research	54.0	50.7
Administrative tasks	18.7	20.
Other work	8.1	10.4

Fig. 1 Simple-cycle gas turbine supercharging a steam boiler

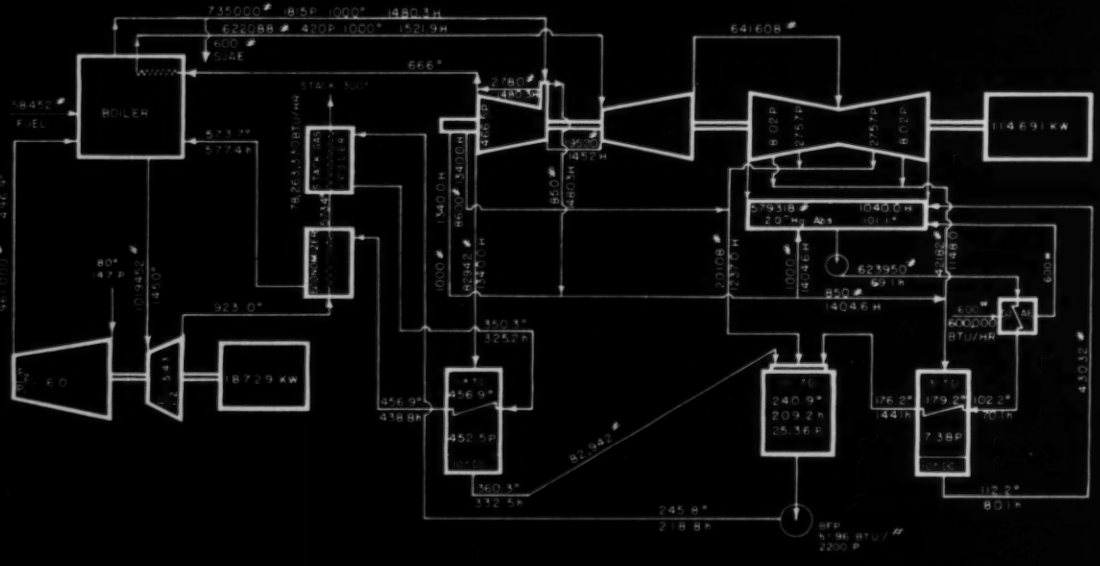


Gains in heat rate and reductions in auxiliary-power requirements, resulting in a smaller power plant are the yields from . . .

Combining the GAS-TURBINE and STEAM-TURBINE

By A. O. White, Mem. ASME and Supervisor, Central Station and Large Industrial Applications Design Unit, General Electric Company, Schenectady, N. Y.

Fig. 2 Heat-balance diagram of combined-cycle plant



STEAM TB GEN OUTPUT	=	114691 KW
GAS TB GEN OUTPUT	=	18729 KW
TOTAL GEN OUTPUT	=	133420 KW
STATION AUXIL POWER	=	3879 KW
NET STATION OUTPUT	=	129541 KW
NET STATION HEAT RATE	=	$\frac{208660 \times 5845\#}{129541}$ = 9413 BTU/KW HR

#	=	FLOW RATE LBS/HR
H,h	=	ENTHALPY BTU/LB
t	=	TEMPERATURE °F
P	=	PRESSURE PSIA

AUXILIARIES

BOILER FEED PUMP	=	2069 KW
CIRCULATING WATER PUMP	=	818 KW
MISC AUXIL POWER	=	573 KW
MISC BOILER LOSS	=	225 KW
1 LOSSES	=	3685 KW
1/95	=	3879 KW

COMBINATION of a gas turbine with a steam turbine is not new. Brown Boveri & Company of Switzerland built such units before the last war and achieved some measure of success. Within the last few years serious study and engineering development in this country have focused attention on the cycle's advantages and economic possibilities. Higher gas-turbine inlet temperatures can now be employed which enable useful output to be obtained from the gas turbine and markedly improve the thermal efficiency of the whole cycle over that of a conventional steam plant.

As shown in Fig. 1, which diagrams the combined cycle in its simplest form, the gas-turbine compressor takes in the total air requirements for the combustion of all the fuel burned, compresses it to 4 to 6 atm, and sends it to the boiler. The boiler comprises the usual steam-generating and superheating surface within one or more pressure vessels in which the combustion of the fuel with the compressed air takes place under pressure. The products of combustion still at pressure, and a relatively high temperature, up to 1450 F at full load, go to the turbine of the gas-turbine set through which they expand to atmospheric pressure, producing sufficient mechanical energy to drive the compressor with a considerable amount left over to drive the generator and generate electric power. Before the hot exhaust gases from the turbine are discharged up the stack at approximately the conventional 300 F, they are passed through heat exchangers where the heat is returned to the cycle, either in the combustion air or the feedwater.

The basic cycle is modified by the various ways and locations at which the exhaust heat can be returned to the cycle. An air preheater can only partly cool the gases, which are normally at a temperature of 450 F to 500 F, by transferring heat to the combustion air. The remainder of the heat must be transferred to the feedwater. Since the higher the temperature at which the heat can be returned to the cycle, the better the efficiency, it is better to absorb as much as possible in an economizer, after the top feedwater heater, and the balance in a stack-gas-cooler at a suitable temperature level. If an air preheater is not used all the heat goes into the feedwater. A third alternative is to put a counterflow heat exchanger in parallel with the top heaters of the steam cycle, and divert sufficient feedwater flow through it to absorb the exhaust heat, cooling the gases to the desired stack temperature and heating the feedwater up to the final feedwater temperature. This gives the minimum mean temperature difference and improves the cycle. Variations of these arrangements are, of course, possible.

This addition to the conventional steam cycle improves the cycle efficiency by 4 to 8 per cent, resulting in a lower net plant heat rate and corresponding fuel rate. Second, it increases the net plant output for a given steam flow to the steam turbine by about 15 per cent. Third, it markedly reduces the size and cost of the steam-generator equipment for a given steam flow and reduces the size of the turbine, condenser, and auxiliaries for a given plant output, as well as eliminating the forced and induced-draft fans.

Contributed by the Fuels Division and presented at the Annual Meeting, New York, N. Y., Dec. 1–6, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from Paper No. 57—A-264, "The Combined Gas-Turbine Steam-Turbine Cycle With Supercharged Boiler and Its Fuels."

The magnitude of the gain in heat rate depends upon the basic steam cycle with which it is compared, the initial temperature to the gas turbine, and, to a lesser extent, upon the arrangement of the heat-recovery equipment mentioned previously. However, taking as an example a 133,500-kw plant, with a steam turbine rated 115,000 kw at 1800 psig, 1000/1000 F 2 in. Hg, and a gas turbine rated 18,500 kw at 1450 F turbine-inlet temperature, and a cycle as shown in Fig. 2, and comparing it with a conventional steam plant of the same net output, with a steam turbine rated 133,500 kw at 1800 psig, 1000/1000 F 2 in. Hg, the comparative heat

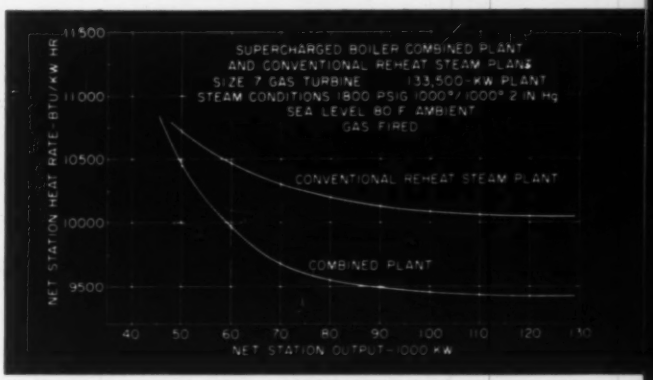


Fig. 3 Net-station-heat rate for supercharged-boiler plant compared to conventional reheat steam plant

rates are shown in Fig. 3. This curve is for a gas-burning plant, with 10 per cent excess air at full load, and constant total-air flow and constant gas-turbine-inlet temperature at partial loads. There is an improvement of 6.1 per cent at full load and a maximum of 6.4 per cent at 57 per cent load. While the curves shown are for natural-gas fuel, with a higher heating value of 20,860 and lower heating value at 18,900, the improvement is approximately the same for any fuel—gas, oil, or coal—assuming the same component efficiencies. The reduction in heat rate ranges from 4 to 5 per cent for a 4500-psig, 1100–1050–1000 F cycle to 8 or 9 per cent for an 850 psig, 950 F cycle, the exact value of course depending upon the cycle and the efficiencies of the components.

These attractive gains are possible because the maximum temperature at which we add heat to a working medium has been raised by 300 to 500 F, while the temperature at which heat is rejected from the cycle is unchanged, resulting in an improvement in the cycle efficiency. Looking at it another way, all the kilowatts generated by the gas turbine are at a 3650 Btu heat rate, since the exhaust heat is utilized in the cycle, while the steam part of the cycle has been depreciated only a small amount by the additional heat rejected to the condenser, Fig. 4.

The effect of various variables on the improvement in plant heat rate over a conventional steam plant is a second-order one, but must be considered in the over-all picture:

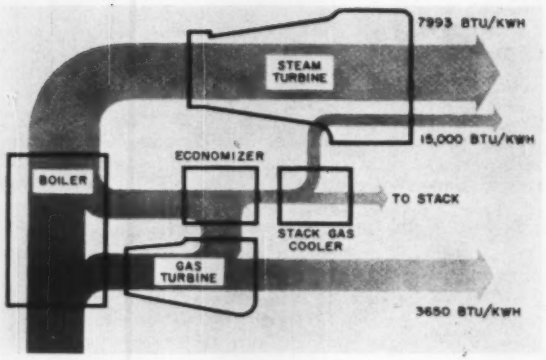
1 Increasing the amount of excess air in the combined

Combining the GAS-TURBINE and STEAM-TURBINE

Fig. 4 *Right,* Energy conversion for the combined-cycle plant

Fig. 5 *Next page, top,* Cross section of a one-shaft gas turbine for the supercharged boiler

Fig. 6 *Next page, bottom,* Artist's conception of the Foster Wheeler supercharged boiler design



cycle, with a conventional reheat steam turbine, from 10 to 70 per cent, results in $^1/_4$ per cent loss in station heat rate at feedwater temperatures above 450 F, and a $^1/_{10}$ per cent improvement in station heat rate at feedwater temperatures below 400 F.

2 The improvement due to the combined cycle increases as the feedwater temperature decreases.

3 The best heat rate for a combined cycle is realized with feedwater temperatures from 400 to 450 F.

4 An increase in stack temperature from 250 to 300 F results in 0.05 per cent poorer heat rate, and a further increase from 300 to 350 F results in $^1/_2$ per cent poorer heat rate when a "stack gas cooler" is used.

5 A change in ambient of +20 F or −20 F results in 0.7 per cent less improvement and 0.5 per cent more improvement, respectively, for the combined cycle over a conventional cycle.

Components of the Cycle

The components of the cycle are the steam turbine, the gas turbine, the supercharged boiler, and the auxiliaries.

The steam turbine. The steam turbine used with the supercharged-boiler combined cycle can be standard in every respect except that it must be good for continuous operation with one or more extractions cut out or reduced and, correspondingly, increased flow to the condenser. Steam conditions should be chosen as high as can be economically justified for the rating. Since the gas turbine produces about 15 per cent of the plant output, the size of the steam turbine is determined by the total plant output required, less the gas-turbine output,

The gas turbine. The basic gas turbine consists of a compressor, a combustion system, and a turbine which generates the power to drive the compressor with some left over to produce the useful output. For the straight gas-turbine plant, complicated cycles can be used including regenerative cycles, intercooled cycles in which the air compression is split up into two or more stages with cooling in between, and reheat cycles in which the expansion is divided into two or more stages and additional fuel burned between expansions. For the combined cycle, the arrangement where the gas turbine is a simple unit in which the boiler or steam generator serves as the combustion system seems best.

The simplest mechanical arrangement is one in which the compressor, the turbine, and the generator are all coupled solidly together and run at constant speed and constant air flow except during starting. A cross section of such a unit, suitable for the 133,500-kw plant already referred to, is shown in Fig. 5.

The supercharged boiler. The supercharged boiler which is used with the combined steam-and-gas-turbine cycle is, of course, the same in principle as a conventional boiler or steam generator, but radically different in configuration. Since the combustion of the fuel takes place under pressure, the heat-transfer rate from the gases to the tubes is several times higher, and the tube area required correspondingly less. Also, a pressure-vessel enclosure is required because of the combustion pressures involved.

All the major boiler manufacturers have investigated the problems involved and have made preliminary designs of suitable units, at least for natural-gas fuel. Foster Wheeler Corporation is the furthest along and have prepared the design for a steam flow of 735,000 lb per hr shown in Fig. 6, based on experience with Navy experimental supercharged boilers. This unit comprises two individual pressure shells, with the heating surface arranged within them.

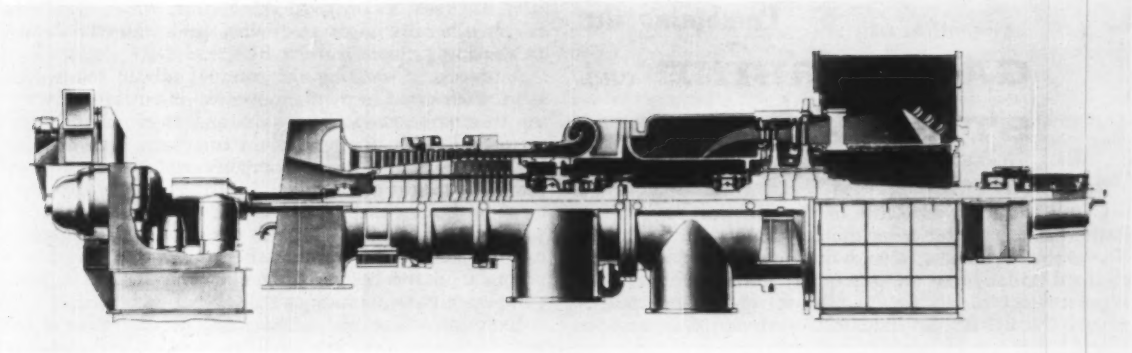
Combustion Engineering, Inc., has made up preliminary designs for approximately the same ratings. Three pairs of units would be used, of which two would contain the superheater, and one the reheater if used.

Babcock & Wilcox similarly have made up preliminary designs for about the same rating as Foster Wheeler and Combustion Engineering.

The general operating characteristics of these boilers are similar to those for a conventional steam generator for the same steam conditions.

Auxiliaries. Net electrical output is improved since forced and induced-draft blowers are replaced by the gas turbine which furnishes air for combustion directly. In addition, most of the auxiliaries are reduced in size about 15 per cent for a given station output.

As mentioned earlier, the heat in the exhaust from the gas turbine must be returned to the cycle, either in an air preheater or in feedwater heaters. If an air preheater is used, it differs from a conventional preheater in that the air side must be good for high pressure. It thus becomes like a regenerator on a straight gas turbine, and is relatively expensive surface. The heat that is transferred to the feedwater requires a relatively simple gas-to-water heat exchanger, usually made up of some form of finned tubes with the feedwater inside, gas outside. However, the mean temperature differential on these heaters must be kept reasonably high to avoid very large



surface requirements and high cost. Whether the surface is arranged as an economizer and stack-gas cooler or a parallel heater arrangement is used, the physical arrangement in the gas-turbine exhaust duct is the same and only the water circuit is changed. Differences in auxiliary-power requirements are significant. The conventional plant requires 6140 kw input to its auxiliaries or 4.6 per cent of its gross output, while the combined plant requires 3879 kw or 2.9 per cent of its gross output, a saving of 1.7 per cent. These figures are based on gas fuel.

Control and Operation

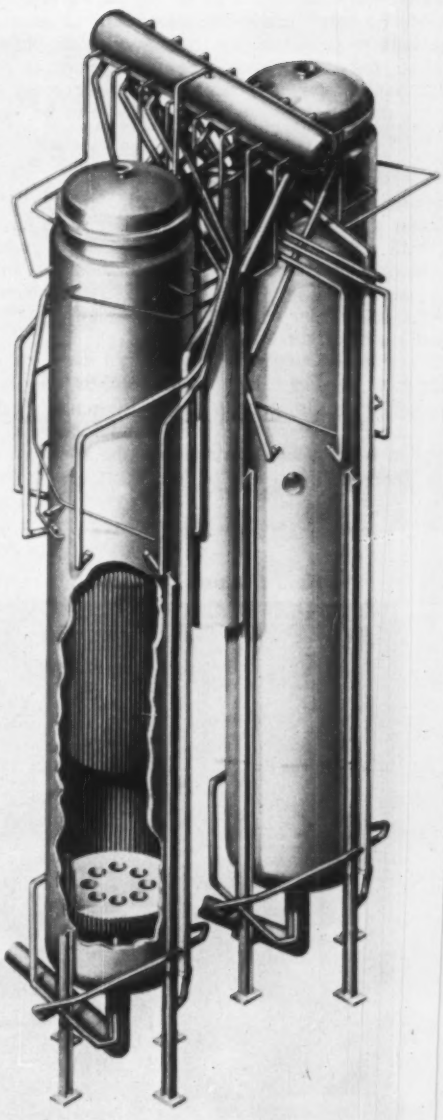
Starting and control have been given careful consideration, and boiler and turbine manufacturers have worked with the manufacturers of control systems to provide all the necessary functions for starting, loading, controlling load, and stopping the plant by systems made up of standard components. Adequate safety devices for the protection of equipment and personnel have been included.

Since each boiler manufacturer has laid out a different arrangement with different control requirements, and the gas turbine can be built with different configurations and characteristics, there can be no one control system that will answer all requirements. The starting sequence for a typical system is illustrated in Fig. 7.

Station Arrangements

As already mentioned, supercharging the boiler results in a marked reduction in the physical size of the steam-generating equipment and its appurtenances, except for the economizer and stack-gas cooler. This is reflected in a corresponding reduction in the total area and volume occupied by the power plant. A typical plant layout is shown in Fig. 8. This demonstrates the compactness of a supercharged boiler plant rated 40,000 kw net output, for gas or oil firing, comprising a 330,000-lb-per-hr, 850-psig, 950 F boiler, a 5000-kw, two-shaft gas turbine, and a 33,000-kw Preferred Standard Steam Turbine. The arrangement of the components can be varied according to the ideas or practices of the operator or his engineers.

Plants of other sizes can be provided by suitable choice of the gas turbine and its air flow. Units up to 185,000 kw combined output can be built using the air flow from a single gas turbine that is presently available. Even larger units could be built using multiple gas-turbine installations with a single boiler and steam turbine.



Combining the GAS-TURBINE and STEAM-TURBINE

The Fuel Problem

Of all the fuels available to the utilities, natural gas is the most desirable from the standpoint of cleanliness. The problems associated with burning this fuel in a supercharged-boiler plant are practically nonexistent, and designs for such plants are available for immediate application to a utility or industrial system. Gas may be burned over a wide range of fuel-air ratios in the furnace, so the combustion control is simple, and an auxiliary or after-burner may be readily provided to maintain the desired temperature of the gas to the gas turbine without affecting the superheat and reheat steam temperatures.

The lack of universal and firm availability of natural gas is its only drawback. Being a premium fuel, its availability for power generation will decrease as time goes on, and an alternate fuel will have to be burned at least as backup.

There are only two alternate fuels of any consequence—liquid-petroleum fuels and coal.

The two main classes of liquid-petroleum fuels are the distillates and the residuals. Distillate fuels have practically no ash and may be burned in any gas turbine or supercharged boiler without any difficulties from deposits or corrosion. The only difference between a supercharged boiler to burn distillate and one to burn natural gas is in the fuel nozzle.

Unfortunately, the price of distillate fuels rules them out for most applications. A gain of 6 to 7 per cent cannot offset approximately a 2-to-1 difference in the cost per million Btu except as an emergency fuel or where the savings in weight and space justify the applications.

The deposit and corrosion problems are severe with residual fuels, particularly at high temperatures. The vanadium salts, present in many residuals, are particularly bad from a corrosion standpoint, while high total ash is generally associated with high rates of deposit on heating surfaces and the like.

A process of treating the residual oils to remove the ash concentrated in them, consisting essentially of washing to remove the sodium salts and then adding metal salts to inhibit the vanadium corrosion, has been developed by the author's company and successfully applied to straight gas turbines.[1] The success of this treatment in the case of fuels for a supercharged boiler has not yet been determined. In the gas turbine, the deposits can be removed by thermal shock, but this may not be practical in the boiler, particularly in a plant required to operate continuously over long periods of time.

Experimental work is under way to determine the extent of the problem in a small pilot plant. Preliminary results are encouraging and it should be possible to adapt present designs of supercharged boilers for use with residual fuels.

Specifications as to the type and quantity of ash in the fuel, or treatment to make the fuel suitable for burning in a supercharged boiler, add to the cost of the fuel, but the increase in the fuel cost should be less than the decrease in fuel consumption based on experience with the straight gas-turbine plant.

With the major part of the electric-power industry burning coal,[2] the supercharged-boiler plant, to be a commercial success, must also burn coal.

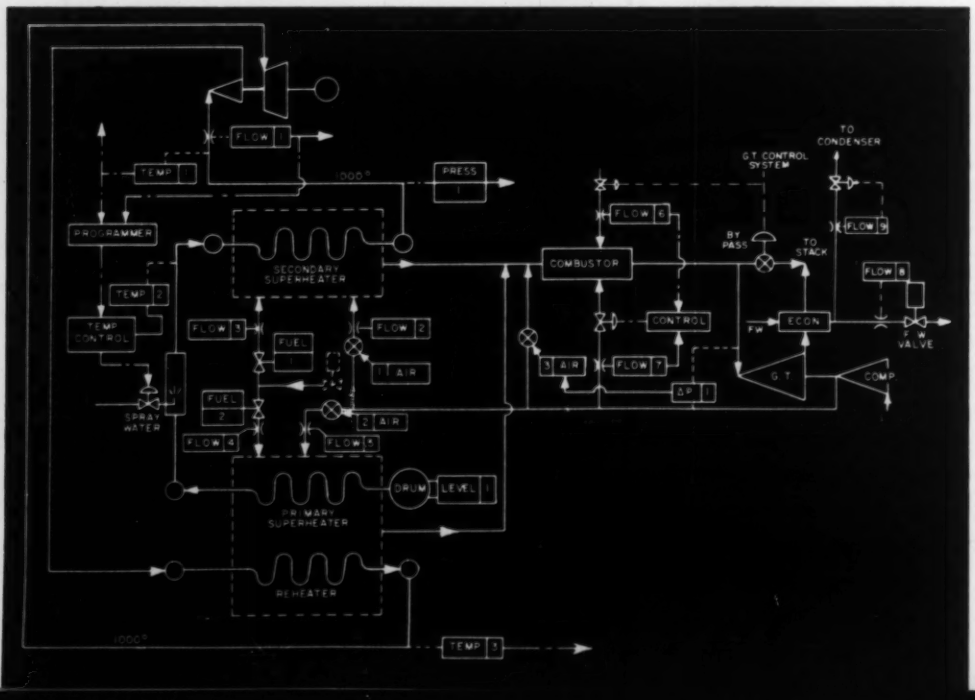
In a supercharged boiler plant, the products of combustion must pass through the gas turbine, carrying with them ash, unburned carbon, and the unburned volatiles. The turbine-gas passages are formed by precision-shaped nozzles and buckets, and any change in their contour due to erosion, corrosion, or deposit will affect the efficiency and life of the turbine and the performance of the whole plant. The fundamental problem is one of erosion, corrosion, and deposit.

Considerable work has already been done on this problem, notably by the Locomotive Development Com-

[1] Buckland, B. O., and Berkey, D. C., "Combustion System for Burning Bunker 'C,'" ASME Paper No. 48—A-108.

[2] Mechanical Engineering, vol. 79, June, 1957, p. 550.

Fig. 7 Control Diagram natural circulation, supercharged boiler with single-shaft gas turbine



mittee of Bituminous Coal Research, Inc., at Dunkirk, N. Y. General Electric has also investigated these problems on a laboratory scale, and most of the conclusions that follow are the result of these two investigations. So far in the investigations, corrosion has not appeared as a factor, but we know from experience with modern steam-generating units that it can be important.

It is fairly obvious that the combustion products cannot be used in the gas turbine without cleaning them of at least the majority of the ash and deposit-forming products. Experiments have shown that ash from a central-station fly-ash-collection system aspirated into a hot gas stream and impacted against $^1/_8$-in-diam specimens results in a fly-ash erosion rate *that varies* as the 5.7 power of the velocity for a fly-ash fraction from 0 to 10 microns and as the 3.7 power of the velocity for a 0 to 44 micron fraction. Also, at 700-fps particle-impaction velocity, the erosion rate with 0 to 44 micron ash is ten times that with 0 to 10 micron ash. Further, the rate for fly ash from various sources can vary at least two to one. An additional observation of interest is that the maximum erosion rate occurs when the stream direction is at 45 deg to the surface.

The provision of either inertial or electrostatic ash collectors between the combustion system and the turbine is a must, in order to achieve any reasonable life from the turbine nozzles and buckets. The experience of the Locomotive Development Committee has shown that, even with fairly effective ash collectors, erosion will limit the life of the turbine.

It has also been suggested, as an alternative to the direct-fired supercharged boiler, that combustion be accomplished by using a pulverized-coal-fired water-cooled producer for a first stage of combustion. This unit would then generate saturated steam for the cycle, and furnish gas of about 100 Btu per cu ft which could then be readily washed clean, and then burned in a second section to superheat and reheat the steam as necessary. The products of combustion from the second section would then be clean enough to use directly in a high-energy, two-stage turbine of minimum cost and maximum simplicity, which would have a life equivalent to that of the steam-turbine part of the plant. In spite of the problems in this approach, it is a very attractive possibility and worth considerable further study and evaluation.

Some of the other variations such as the exhaust-heated cycle, feedwater heating, boiler-feed-pump drives, and so forth, are covered in other papers in the references.

In conclusion, it should be emphasized that the supercharged-boiler cycle gives a larger gain in thermal efficiency than any other step in steam power plants that can be foreseen, at a capital cost per kilowatt that is comparable to that for a conventional steam plant. It is an eminently practical cycle for those areas that have an adequate supply of natural gas, and its ability to burn the other low-cost fuels is certain to come in time. Such a plant should be placed in service to prove the principles and obtain operating experience. General Electric and the boiler manufacturers are ready to furnish the equipment for a gas or distillate-burning plant, and should soon be in a position to do so for residual oils.

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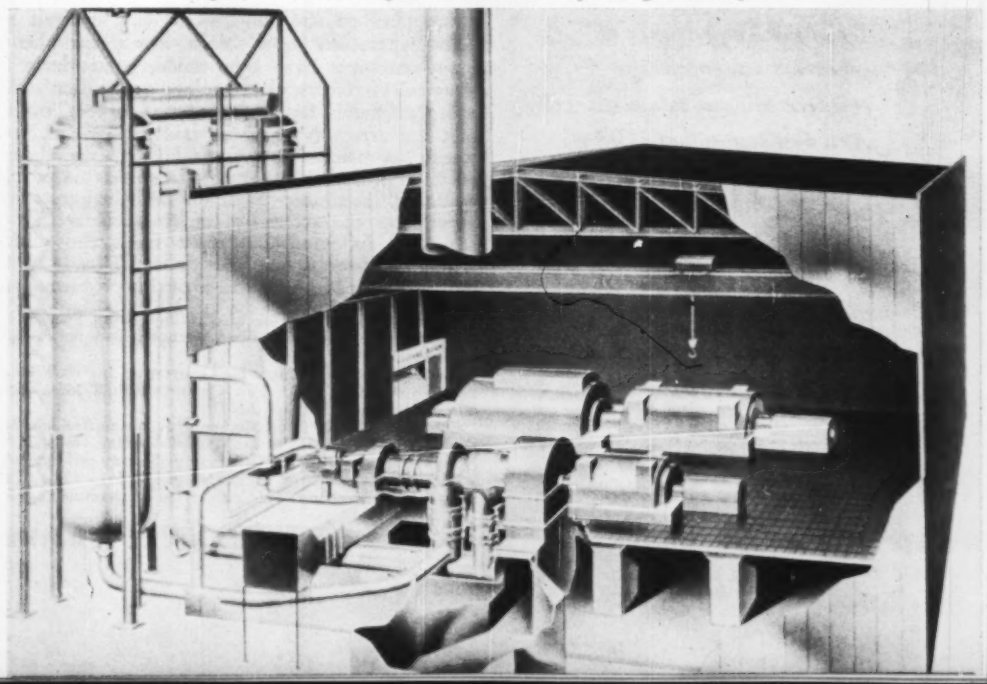
Fig. 8 Turbine floor plan for 40,000-kw supercharged-boiler plant



In late 1955, the Executive Committee of the ASME's Hydraulic Division created a new subcommittee. Its objectives:

To encourage application of existing theoretical and empirical knowledge to design of mechanical-engineering devices.

Unresolved problems of fluid mechanics

By S. J. Kline[1] and R. C. Dean, Jr.[2]

To search out and define unresolved problems; to assess which are of most importance to engineers; to encourage research toward solutions. As a first step toward definition of the important fluid-mechanics research problems, a survey of industry, government, and university personnel in both research and design was conducted. In this article, the authors present their conclusions, drawn from the survey and their own experience.

THE purpose of the study of fluid mechanics in mechanical engineering is to provide rational and accurate means for predicting the behavior of fluids in devices of interest to the mechanical engineer. As used here, the term "prediction" has three elements: (*a*) prediction of over-all behavior in a general or qualitative sense; (*b*) prediction of numerical results on performance and losses; and (*c*) prediction of optimum design under prespecified conditions and for a given purpose.

Elements (*a*), (*b*), and (*c*) represent successive stages of refinement. In almost all engineering work, stage (*c*) is the ultimate goal, but in many common problems we find frequently that we cannot even reach stage (*a*) with any reasonable degree of assurance. It is in such areas that research work is particularly needed.

In the large majority of mechanical-engineering applications, the fluid motion occurs inside a passage. The shapes of these passages are usually complex, and often they are in motion. This aggravates the difficulties, since available analytical methods are often poorly suited to such configurations.

Returns From the Survey

The results of the survey made by the Fluid Mechanics Subcommittee suggest that two general types of unsolved problems are currently of most concern to mechanical engineers. The first, and apparently by far the most common, is stall or flow separation and its associated transient effects. Over fifty per cent of all the responses related directly to this one subject.

Next appears to be two-phase flow—flow in chemically reacting systems, and other areas, where the flow is not composed of a single simple substance. However, this topic excited only about seven per cent of the responses, and no other single topic encompasses more than a few per cent of the total.

While the sample size in the survey was not large, a conscientious effort was made to obtain a broad and representative sample. Therefore, the extreme preponderance of answers on the one topic forms a clear indication—prediction of the onset and behavior of flow separation and its associated transient effects is a central need.

What, if anything, can be said regarding profitable approaches to the solution of this difficult problem? Flow separation is, of course, not a new phenomenon; many attempts have been made, particularly by aeronautical engineers, to correlate or predict stall results using primarily boundary-layer theory. To date, none of these attempts has been truly successful, and recent researches reveal that present-day boundary-layer theory by itself is probably not able to solve this problem. In addition, available evidence also suggests that the separation characteristics of channels are, at least in stability, inherently different from those of airfoils where most work has been done. Thus it appears that we must re-examine the bases of this problem.

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Contributed by the Fluid Mechanics Subcommittee of the Hydraulic Division, and presented at the Annual Meeting, New York, N. Y., Nov. 30–Dec. 5, 1958, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from Paper No. 58—A-211, "The Central Unresolved Fluid Mechanics Problems of the Mechanical Engineer."

Basic Approaches

For design problems involving fluid mechanics, four basic approaches are possible: 1 Calculate everything based on the theory of real fluids; 2 Measure everything for each application; 3 Measure for typical applications and attempt to correlate the results; and 4 Observe typical basic elements, preferably over a wide range of conditions, and build a suitable approximate theory on the models found.

As the history of fluid mechanics shows over and over again, 1 is not a feasible solution; the equations are too difficult. Method 2 is clearly impractical. Hence 3 and 4 appear to be the useful and promising methods.

As both recent researches and the history of fluid mechanics also show, the fundamental reason for the important role of systematic observations, and formation of simple models based thereon, is the recurrent stability problems that occur in viscous-fluid motion.

By definition, the actual flow pattern found in nature is the stable one for the conditions imposed. Since we cannot calculate the stable-flow pattern in viscous flow, we must almost always determine it by observation. This appears obvious, but it might be well to recall that no one has yet taken the trouble to perform systematic visualization observations of so common a configuration as a sudden expansion and, as a result, no criterion exists to predict whether a particular expansion will act as a shedding wake or as a steady, fully developed stall. These two regimes are very different, both in steadiness and in regard to losses. Nor is this an isolated example; many more could be cited.

It is also helpful to examine cases where the problem has been made manageable by past research work. Examples: Flow over a subsonic airfoil, and fully established flow in a round tube. In both of these comparatively simple situations, a very important, if not key, part of the present-day manageability arises from information of a certain specific type—experimental knowledge of the over-all stable-flow pattern.

In the case of the airfoil, this takes the form of the Kutta condition, with data showing the limits of angle-of-attack for which this condition will hold true. In the case of the tube flow, it takes the form of the Stanton-Pannell plot showing the laminar, turbulent, and rough zones, with the intermediate transitions as a function of Reynolds number and relative roughness. In both instances, no theory is available that will replace this essential information: What type of flow pattern is the stable one that will actually be found under given conditions? Once this is known, then the way is cleared to apply exact or approximate theories for prediction.

Returning to the central problem of passage flow, it would appear that the missing information in many important geometries is the knowledge of the stable-flow pattern. This is fully borne out by recent work on a number of geometries including disk flows, simple diffusers, and cascades. It appears now that some of these problems are not as unmanageable as has been thought, and the method of attack to which they yield is fairly clear.

Method of Attack

It commences with systematic investigation of the stability problems of the given geometry, preferably including visualization studies. Only after this is done, does it proceed to theories of prediction. Usually, the whole process must be iterated toward a successful closure.

This method of attack implies that in many situations we must augment the classical modes of analysis which are based solely on two-dimensional and three-dimensional steady-boundary-layer theory. We must also learn not only when stalls will occur, but what types of stalls are found and the primary elements of behavior of each type. In many practical flow problems, design compromises necessitate the acceptance of a stalled flow.

Since at present we have only a partial qualitative understanding of stall behavior, the designer is frequently faced with totally unpredictable flow situations However, if we are willing to spend the time, effort, and money to carry out systematic observations, experience indicates the likelihood of making manageable our most pressing problems in fluid flow.

The Full Report

The major conclusions of the full report are presented here, to provide a more complete picture.

1 The central fluid-mechanics problem of the mechanical engineer is prediction of the pattern and performance of the flow in passages of all types. Despite this, a number of very common geometries appear to have had little or no investigation along what appear to be the most promising lines of attack.

2 Conclusion No. 1 strongly suggests that a continuing need does exist for a co-ordinating body on mechanical-engineering fluid-mechanics problems; that the lack of such a body in the past has been partly responsible for an overdependence on the methods laid out by aeronautical engineers for the problems of external flow.

3 The most pressing research needs of mechanical engineers in fluid mechanics still lie in the areas of shearing flow and large-scale transient phenomena. These phenomena are probably related to a large extent. Prediction of the advent and behavior of stall is perhaps the most pressing single problem

4 The most promising method of attack on the problem in 3 and on the problem of improved passage-design methods appears to be along the lines of systematic gathering of data, involving both quantitative results and careful visualization. In many cases, data which are essential to both prediction of over-all patterns and to formulation of rational theory are not available today.

With the above results and discussion in mind, the Fluid Mechanics Committee of the Hydraulic Division has scheduled a symposium on stall for the 1958 Annual Meeting of the Society.

The committee plans to organize further sessions and symposiums on other problems at a later time,[3] and hopes to serve as a co-ordinating body for the fluid-mechanics problems of mechanical engineers. The committee will also encourage research and aid in the rapid dissemination of results wherever possible.

However, this committee by itself can only assist. The investigators in industry, the universities, and government laboratories, and the designers and development engineers concerned—and particularly the managers of industry—must provide the knowledge, means, willingness, and support to make a fresh attack on these problems, to decrease the disparity between much of our fluid-mechanics analysis and the realities in optimization of actual mechanical-engineering equipment.

[3] Probable topics are listed in the complete report; further suggestions will be appreciated.

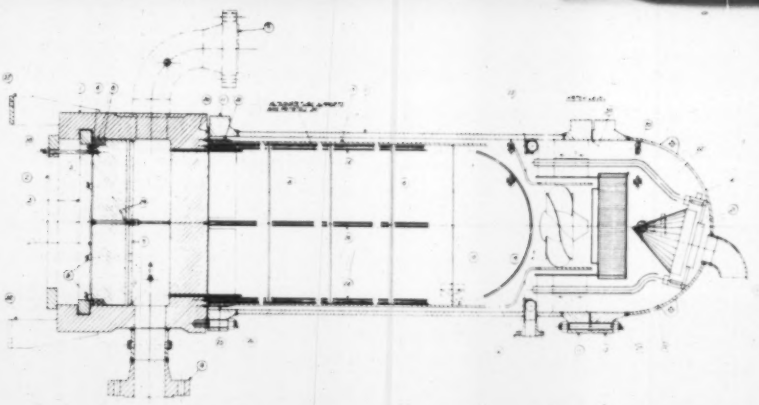

Fig. 1 Cross-sectional view of the test vertical steam generator (here shown horizontally). The pressure-sealed channel construction and the two shell flanges which were incorporated in the design to provide accessibility are shown.

Performance Tests of a Vertical Steam

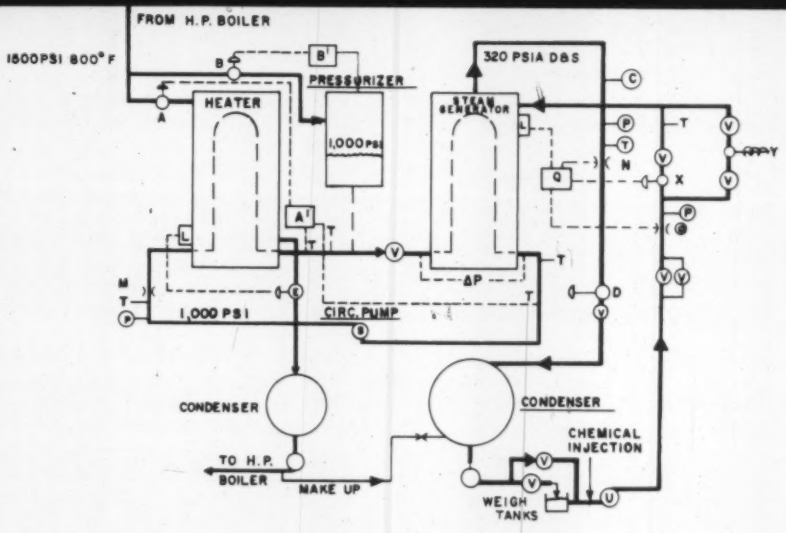

Fig. 2 Line diagram of test facility. A—control valve supplying steam to shell side of primary water heater; A′—temperature-sensitive controller for valve A; B—control valve supplying steam to pressurizer; B′—pressure-sensitive controller; C—Ellison U-path-type throttling calorimeter; D—steam-control valve which corresponds to turbine-governing valve; E—drain valve which discharges condensate; L—water-level recording; M—recording flow nozzle for primary water; N—recording flow nozzle for steam flow; O—recording flow nozzle for feedwater; P—pressure gage; ΔP—differential pressure gage; Q—3-element feedwater controller; S—canned motor pump; T—thermometer of thermocouple; U—boiler-feed pump; V—manually operated valves; X—pneumatic feedwater control valve; Y—electric feedwater control valve.

In 1955 the authors' company began the design of vertical steam generators for application in nuclear power plants. The unit, Fig. 1, consists of a vertical shell and U-tube bundle with an integral steam drum and downcomer. The tube bundle is surrounded by a "wrapper" of thin material which forms an annular passage between the wrapper and the pressure shell for a downcomer. The bottom of the wrapper is ported, permitting flow from the downcomer to the tube bundle. Boiling takes place in the tube bundle and, due to the difference in density between boiling water in the bundle and saturated water in the downcomer, natural circulation is established. The top of the wrapper is of reduced diameter and contains a centrifugal device which serves as the first stage of separation. The bulk of the water is removed at this point and returns to the upper portion of the downcomer. The annular area between the shell and the separators is quite large at this point thus providing water storage. The normal water level is in this part of the unit. The steam drum is merely an extension of the shell, and contains two stages of moisture separators. The first stage consists of a square array of vertical chevron-type separators, while the final separation is accomplished by a Centrifix purifier.

Since this was the first vertical U-tube arrangement to be designed for nuclear application, it was felt that full-scale performance tests should be conducted. The test program included over-all performance testing to confirm the adequacy of the design as well as detailed studies of heat-transfer rates, pressure losses, and the transient response of the steam generator.

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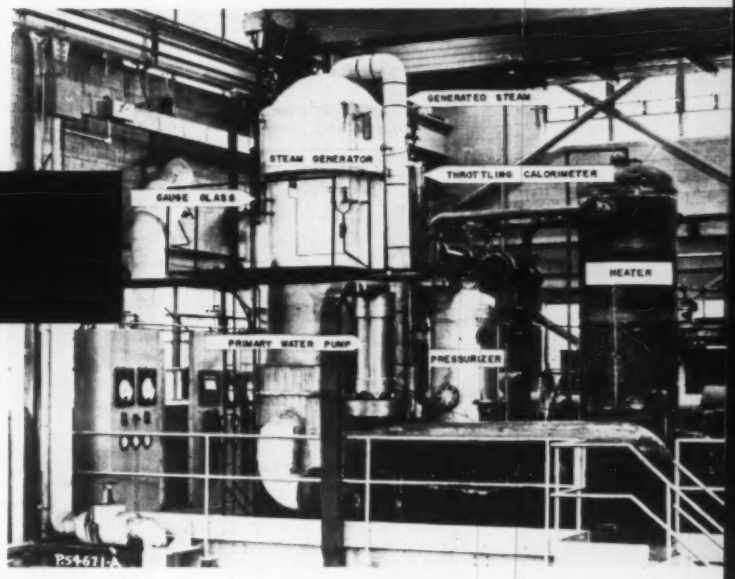
Contributed by the Power Division and presented at the Power Conference, Boston, Mass., Sept. 28–Oct. 1, 1958, of The American Society of Mechanical Engineers. Paper No. 58—Pwr-1.

Fig. 3 The test facility installed in the laboratory



By R. L. Coit[1] and C. C. Peake[2]
Westinghouse Electric Corporation, Lester, Pa.

Generator for NUCLEAR POWER PLANTS

Full-scale performance tests were conducted on a vertical steam generator with high-pressure steam used as the heat source instead of nuclear energy. Otherwise, test conditions simulated or exceeded those in actual service.
The steam generator consists of a vertical shell and U-tube bundle with the upper portion of the shell serving as the steam drum. The tube bundle is surrounded by a "wrapper" leaving an annular space between the tube bundle and shell which serves as a downcomer for natural circulation.
The steam generator was evaluated under transient as well as steady-state conditions. Performance characteristics were found to be excellent, particularly during very rapid load changes.

Test Facility

A line diagram of the test facility is shown in Fig. 2. Fig. 3 shows the test facility installed in the laboratory.

The primary-coolant system is a closed loop of carbon-steel pipe in which pressurized hot water is circulated. The pressure level of the primary loop was chosen as 1000 psi rather than the normal working pressure of 2000 psi. Since the pressure dependence of the properties of water is small, and can be accounted for, it is felt that we have not introduced any uncertainty into the tests.

The main coolant pump is a canned-motor-driven centrifugal pump. A high-pressure feedwater heater is used to supply the heat which is removed by the steam generator. This has adequate capacity to establish any of the desired primary-coolant transients and is supplied with 1500-psi, 800 F steam.

The secondary loop is also shown in Fig. 2. The steam generated in the test unit flows downward in a carbon-steel pipe, through a flow nozzle, symbol N, through a pneumatic control valve D, into a laboratory condenser.

The water level in the boiler is controlled by a system which senses steam flow, feedwater flow, and water level, and then sets up a control signal based on these measurements. One instrument records compensated steam flow, steam pressure, and steam temperature, while a second instrument records feedwater flow and water level. These synchronized records supply correlated data for all tests.

The entire loop is controlled automatically except for changing the steam output by regulating the pneumatic loading pressure to valve D.

Results of Tests

Steady-state operation. During steady-state operation,

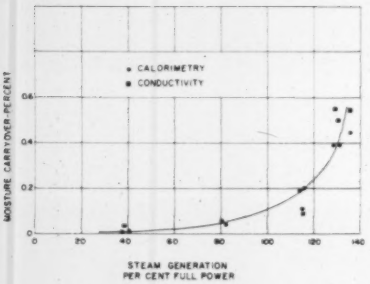


Fig. 4 The moisture carry-over as a function of load for the complete load range

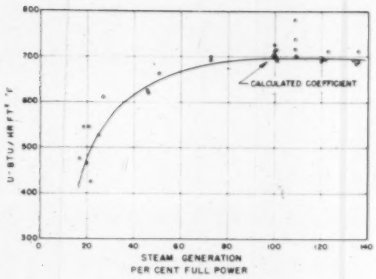


Fig. 5 Heat-transfer performance of the vertical steam generator

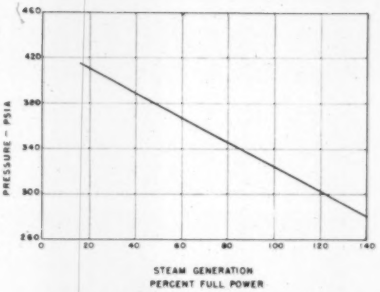


Fig. 6 The steady-state equilibrium pressure at various loads

Transient tests of the vertical steam generator

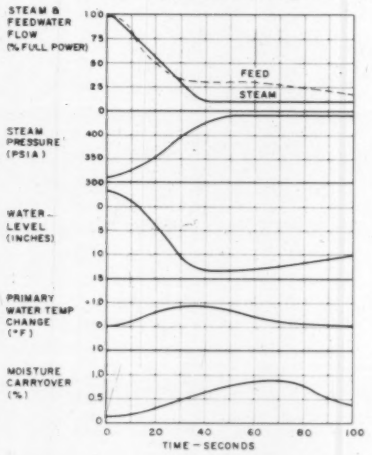


Fig. 7 A rapid load decrease from 100 to 15 per cent in 35 sec. The apparent moisture content of the steam increases to approximately 1 per cent during load change.

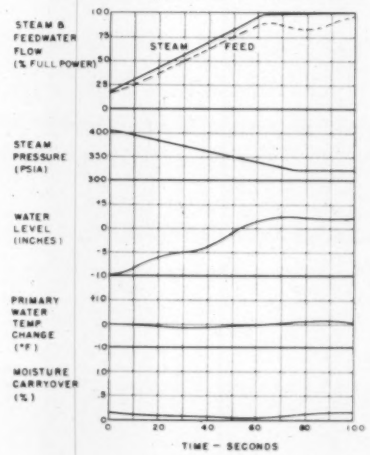


Fig. 8 The normal load-increasing transient of 15 to 100 per cent at approximately $1^1/_2$ per cent per sec. Moisture carry-over decreases to practically zero.

the important question is: Can the steam generator produce the design steam output at the required quality when it is supplied with the correct quantity of primary water at the design temperature? Fig. 4 shows the moisture carry-over as a function of load for the complete load range. The calorimetry technique was especially valuable in determining transient performance study.

The boiler has been operated over its complete load range with water levels from −10 in. to +12 in. without excessive moisture carry-over. During steady-state operation at full power with a water level of +14 (2 in. of the chevrons submerged), the carry-over was 0.5 per cent. During an increasing power transient in which the initial water level was +3 in., the peak water level was +19. At this water level, the chevron separators are completely submerged. The moisture carry-over in this case was 1.0 per cent. This is important in that it shows that under extreme operating conditions no gross carry-over will occur.

Normal operation has been with low-total dissolved solids, 200 to 400 ppm, in the boiler, but the unit was also tested with high-total solids in the shell. Chemicals were added to give a pH of 11.2 and 280-ppm phosphates, and then sodium sulfate, Na_2SO_4, was added until the total solids content was 1200 ppm. The boiler was operated at full-load steam flow with water levels from +3 to +11 in. without exceeding 0.25 per cent moisture carry-over. Tests at 120 per cent full-power steam flow showed that excessive moisture carry-over does not occur at overload.

Heat-transfer performance. The effect of load on the over-all heat-transfer coefficient is given in Fig. 5. The full-load heat-transfer coefficient was calculated to to be 702 Btu per hr per sq ft-deg F. The curve demonstrates that the heat-transfer ability of the unit is very close to the calculated value. The degree of cleanliness of the test unit is difficult to define quantitatively, but, due to intermittent operation, the test unit probably has at least as much fouling resistance as will accrue under service conditions. The variation of the heat-transfer coefficient is due to the change in the boiling coefficient as the mean temperature difference between the primary water and the boiling fluid varies. The steady-state equilibrium pressure at various loads is shown on Fig. 6.

Transient Tests

Scope of tests. A desirable feature of any steam power plant is the ability to accomplish rapid power transients without encountering carry-over or other abnormal conditions. The construction of the vertical steam generator is such that rather fast temperature changes can be tolerated with minimum thermal shock. It was therefore decided to determine the operating capability of the unit under transient conditions. Of particular interest is the rate of change of water level and moisture carry-over during rapid load changes.

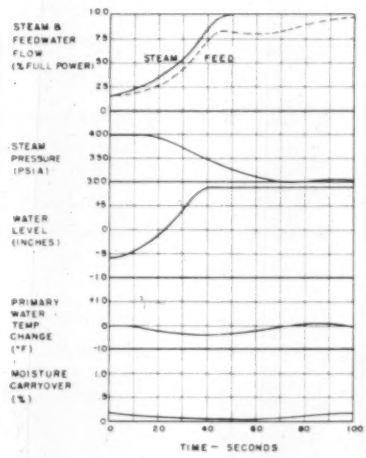


Fig. 9 A more rapid increase to full load in 45 sec. The water level increases from −6 to +9 in. in accordance with an automatic water-level programming.

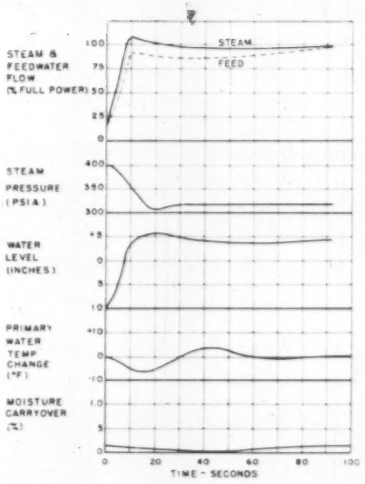


Fig. 10 Increase to full load in an interval of 8 sec. The water level increases from −10 to +6 in., then drops below +5. Moisture carry-over remains low.

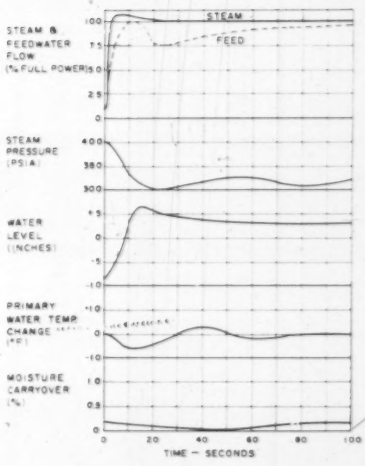


Fig. 11 When increasing load change occurs in less than 15 sec, the "swell" results in a temporary increase in water level above the programmed value, as in Fig. 10

Figs. 7–11 indicate the response of the various parameters during the following transients.

Fig. no.	Load range, per cent	Nominal duration of transient, sec
7	100 to 15	35
8	15 to 100	60
9	15 to 100	45
10	15 to 100	8
11	15 to 100	3

Test results. Note that, during the load decrease described in Fig. 7, the moisture content of the steam is shown as increasing to approximately 1 per cent. The performance of the separator would be expected to improve as the load decreases and the pressure rises. Our calculations indicate that both the observed improvement in steam quality during increasing transients, and the deterioration of quality during decreasing transients, can be attributed to an exchange of heat between the flowing steam and its associated piping. For example, while operating at 100 per cent load, the steam drum and piping will reach the saturation temperature for 100 per cent load. When the load is quickly decreased, the saturation temperature increases and heat flows from the steam into the steel. Any metal surfaces which are downstream from the purifier—and some portions of the purifier itself—would extract heat from the steam and increase the moisture content. The shape of the quality curves, and the heat-flow time constants of the pipe, support the hypothesis that the steam quality is being modified by this heat exchange. Our concern in this problem is to establish that there is no bulk carry-over which might damage the turbine. There appears to be no actual deterioration of steam quality occurring other than that due to slight condensation in the top of the drum and the steam-offtake piping.

Level controls. The water-level controls used for the first series of transients tests were of conventional, pneumatic, three-element design. Reference to the transient curves shows that the feedwater flow closely follows the steam flow during both increasing and decreasing transients. Comparison of the transient response of the water level with the steady-state programming indicates that the main control function being exercised is to allow the water level to adjust to its steady-state programmed level.

The time constant of the water-level recorder was determined by imposing large step changes on the instrument and observing the response. It was found that the time constant—time required to realize 63 per cent of the imposed change—of the sensing and recording elements was 9 sec. This delay tends to obscure the maximum swell which actually occurs during rapid transients for two reasons: (*a*) During the transient some steam is generated and leaves the system, thereby decreasing the mass to be stored in the drum; and (*b*) if the swell is assumed to be "dynamic," that is, non-

Performance Tests of a Vertical Steam Generator for NUCLEAR POWER PLANTS

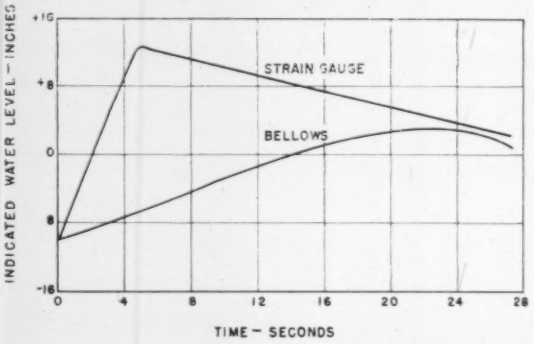


Fig. 12 Comparison of strain-gage and bellows water-level records during an increasing power transient from minimum to full power in 2 sec

equilibrium, the water-level recorder cannot note the peaking effect.

During the testing of the electric-type boiler controls, a fast-acting differential-pressure cell was installed to record water level. This cell uses strain gages on a diaphragm to sense differential pressure. The diaphragm travel is very small, hence there is essentially zero flow in the meter lines during a change in level. The instrument is very fast and can record the peak water level.

A comparison between the bellows-type recorder and the fast-acting strain-gage instrument is shown in Fig. 12. The strain-gage record is very similar to the calculated actual level, which was predicted on the basis of the bellows record, and its known time constant.

During one series of tests, water level, steam flow, and pressure were recorded on high-speed charts. Referring to Figs. 13 and 14, it can be seen that there is essentially no time delay between the steam-flow change and the water-level change during an increasing transient. The curves show that the water level reaches a maximum and immediately begins to decrease when the steam flow reaches the new rate, even though the pressure continues to decrease for a relatively long period. Figs. 13 and 14 differ only in the feedwater flow, which was zero for Fig. 13, while in Fig. 14 it was set at 100 per cent flow just before the transient was initiated. The swell with zero feedwater is seen to be 2 in. greater than with 100 per cent feedwater. The swell-suppressing effect of feedwater is clearly shown, but its magnitude is fairly small. It does show, however, that the feedwater control should not shut off the feedwater in an attempt to reduce swell. Note that the cooling effect of the incoming feedwater is sufficient to reduce the level.

Decreasing load transients with and without feedwater also show that the change in water level is a function of power change, and that feedwater-flow rate has a small effect.

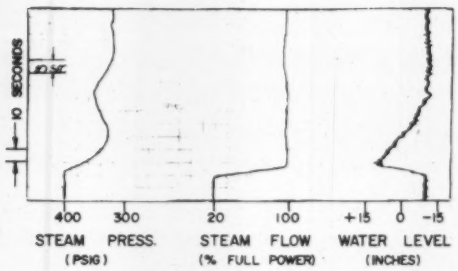


Fig. 13 High-speed charts recorded water level, steam flow, and pressure in this figure and in Fig. 14. Both were for increasing transients.

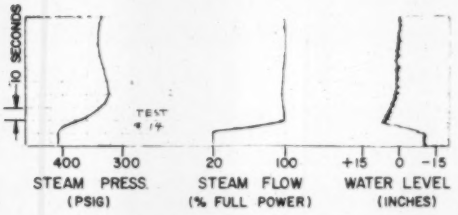


Fig. 14 The two figures differ only in feedwater flow. For Fig. 13 it was zero, while in this Fig. 14 it was set at 100 per cent flow just before the transient was initiated.

Summary

1 Heat-transfer performance. The tests show that, based on existing theory, the heat-transfer performance can be predicted with a good degree of accuracy.

2 Transient performance. The transient performance of the unit is excellent. Power may be increased or decreased at any rate over the entire load range. All transients are quite orderly, and steady-state operation is rapidly recovered. It has been shown that feedwater-flow control during a transient is not critical. A fast-acting automatic control produces a result that is very similar to a manual adjustment of the feedwater valve.

3 Moisture carry-over. Under steady-state conditions, moisture carry-over as measured by calorimetry and by conductivity does not exceed 0.25 per cent at any load less than 120 per cent. During increasing load transients the observed moisture content *decreases*, while for fast-decreasing load transients the observed moisture content increases above the 0.25 per cent value. This is attributed to heat exchange in the steam piping rather than to any change in separator performance.

4 Level controls. The boiler was tested with three different sets of level controls. The first was a pneumatic system, and the other two were electric. Each was a three-element system, sensing steam flow, feedwater flow, and water level. All three were quite satisfactory from a boiler viewpoint. Water-level control is not critical. It has been shown that operation is essentially the same for any water level from −10 to +12 in. Minor feedwater-flow fluctuations do not affect the operation.

The only requirements of the control system are that it be capable of maintaining the water level within reasonable limits without large feedwater-flow fluctuations. An extremely fast-acting control is not necessary even for rapid load changes.

As automation grows, so does maintenance —and down time is the core of the problem. A designer of machine tools for the automotive industry discusses elements that make for ready servicing. Control down time, and you control maintenance cost.

The Transfer-matic, a completely automatic machine tool, with 270 stations divided into 17 sections. It performs 2291 operations on 185 cylinder blocks simultaneously, with a minimum of down time for setup and maintenance.

Designing to Reduce Down Time

By D. I. Dumond, Assoc. Mem. ASME

Engineering Manager, The Cross Company, Detroit, Mich.

MAINTENANCE costs can be controlled through design. Although the designer may incorporate many components and parts in his design which may never require maintenance, there are others that must be maintained. If he has not reviewed his design to be sure that it fulfills three important criteria, it may require excessive maintenance. This paper outlines these three criteria which we have found to be effective in controlling maintenance costs by reducing down time.

The greatest maintenance costs occur when a machine is not operating, for at this time a double loss occurs. First, that of production, and second, the actual cost of doing the maintenance work. In controlling maintenance costs our greatest effort should be in the direction of reducing down time.

Today's management is well aware of this problem. Del Harder, Ford Motor Company, generally accredited for coining the word "Automation," recently said: "Another thing we need is greater ease of maintenance built into the machines you (machine tool builders) produce. Motors, clutches, and drives should be arranged for rapid removal when replacement becomes necessary."[1]

Review Your Design

The machine designer of today is equipped to accomplish this by reviewing his designs to see that they

Contributed by the Machine Design Division and presented at the Annual Meeting, New York, N. Y., Nov. 30–Dec. 5, 1958, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. ASME Paper No. 58—A-131.

[1] E. J. Egan, Jr., "Machine Tool High Spots," *Iron Age*, vol. 179, no. 1, Jan., 1957, p. 193.

control down time. We have found that it can be controlled when designs fulfill the following criteria:

1 Simplicity
2 Interchangeability
3 Flexibility

Simplicity. Obviously the simplest design will require the least number of parts and the parts that are required will have the least complex configuration. This will result in improved maintenance, whether we look at it from the point of view of merely having fewer parts which will wear, or the reduction of work involved in the replacement. Dr. Lee DeForest once said, "Complexity is a confession of poor design."

Interchangeability of components. The designer has a great influence in making individual components and parts interchangeable. Through his design of various units or mechanisms he can design their components so that they are interchangeable. This not only saves the manufacturer the needless cost of additional tooling, but also the user of the equipment from having to maintain a large inventory of parts for maintenance.

Flexibility. Flexibility in a design provides the ease of maintenance feature. It is accomplished by having components interchangeable with each other. Not only will the required maintenance be performed easier, but also, the user of the equipment has to maintain a much smaller inventory of maintenance components.

One of the factors the designer must take into consideration while examining his design for simplicity, interchangeability, and flexibility is the frequency of maintenance that will be required on the components and parts. Some will have a higher frequency of maintenance than others. Those with the highest frequency are termed perishable and should have top priority in so far as study for ease of maintenance is concerned.

Those with a lower frequency of maintenance are termed semidurable and should be considered second only to perishable items.

The Perishable Component

Some of the perishable parts to consider in any machine tool are: cutting tools, locating pins, and pads.

The designer has at his command a wide range of standard cutting tools. This includes: drills, reamers, taps, milling cutters, as well as holders and drivers for them. Therefore, standard tooling should be used wherever possible throughout the design. This will not only save on the initial cost but will also allow the user to maintain a smaller inventory of cutting tools.

Besides the use of standard tooling, the design should incorporate preset tooling for every tool. Preset tooling reduces the amount of lost production due to tool change, as well as the elimination of parts scrapped due to tool adjustment during tool change. This is accomplished by having sharp tooling set to proper dimensions, outside of the machine, that require no further adjustment when installed. Thus when a tool change is required, it involves nothing more than the replacing of dull tools with preset sharp tools (Fig. 1).

Locating pins and locating pads in a machine tool receive abusive wear. They are replaced frequently since their location of the workpiece determines its quality. Their replacement must be accomplished in a short period of time. This is done by having these parts manufactured to tolerances, as well as by design that permits interchangeability. When these parts are manufactured to interchangeable tolerances, a fitting operation on an adjacent nonmaintenance part, if need be, can be done as the machine is being built (Fig. 2).

Examples of semidurable components and parts in any machine tool are: oil seals, hydraulic cylinders, limit switches, and solenoids. The best way to reduce maintenance on these components is to simplify the design by eliminating them.

Cut Down on "Semidurable"

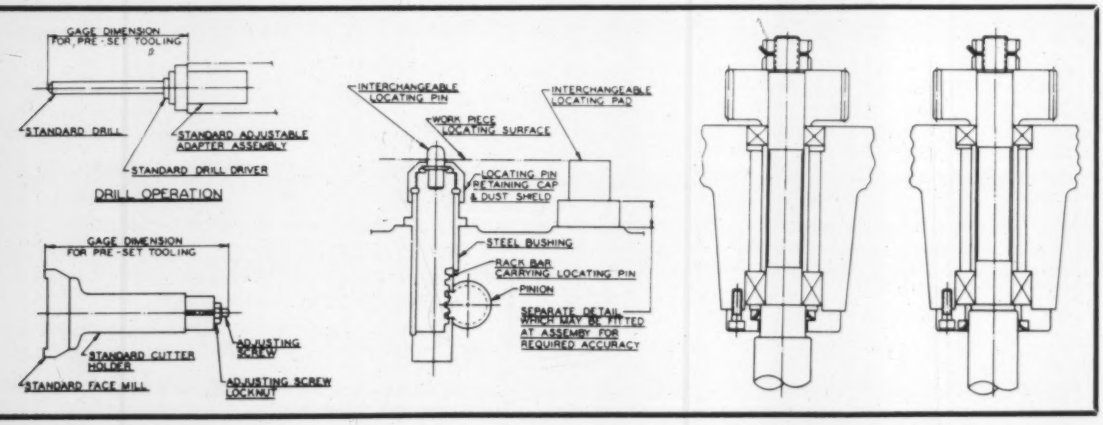
A good example occurs in a transfer-type machine. In the machine, the workpiece is transferred from station to station. The machine has movable locating pins which engage and disengage the workpiece at each of sixteen stations.

Consider the actuation of these sixteen sets of locating pins. Normally, a hydraulic cylinder driving a rack and pinion, plus two limit switches and a solenoid operated hydraulic four-way valve, is used to activate the

Fig. 1 Preset vs. standard. Preset tooling reduces down time, cuts part spoilage during adjustment.

Fig. 2 Replaced frequently, locating pin and pad require interchangeable tolerances

Figs. 3 and 4 The right and wrong of oil seals. Spindle at right, easily serviced, need not be removed to replace oil seal.



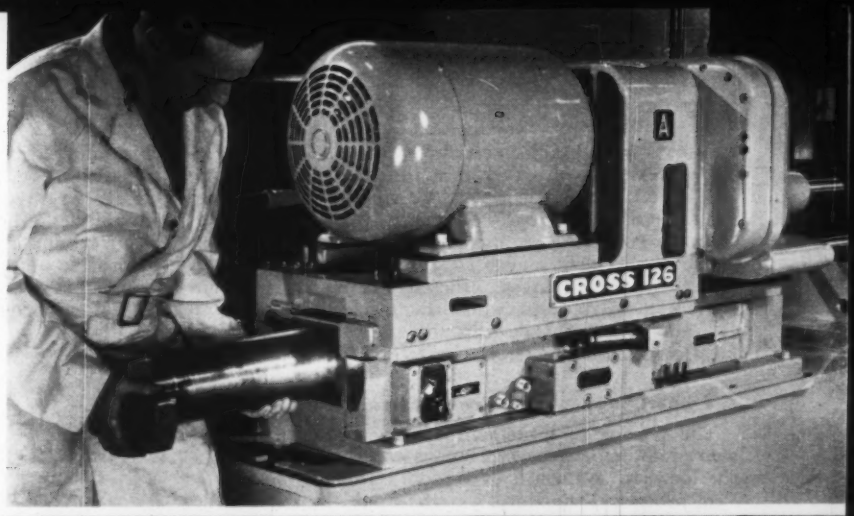


Fig. 5 Wisdom in the design of a hydraulic cylinder. The cylinder is so mounted that it can be removed—and the packing maintained without having to remove the head.

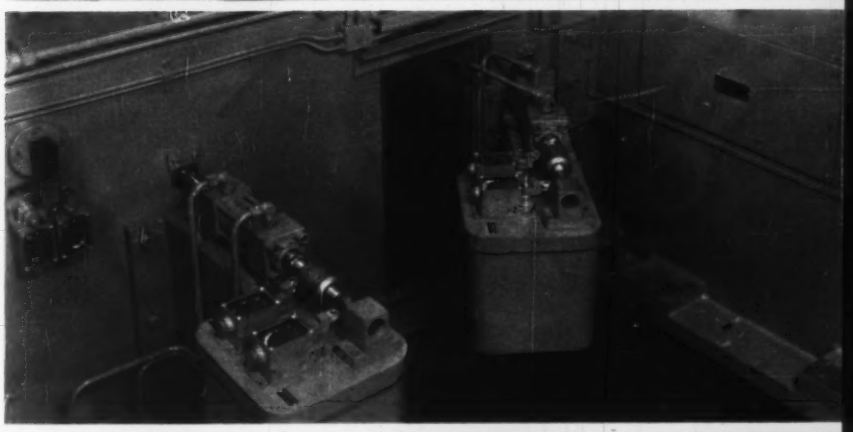


Fig. 6 Another design for ease and speed in maintenance of hydraulic cylinders, where packing is the part requiring the most maintenance. Here, the cylinder is mounted outside so that the packing can be readily reached for maintenance.

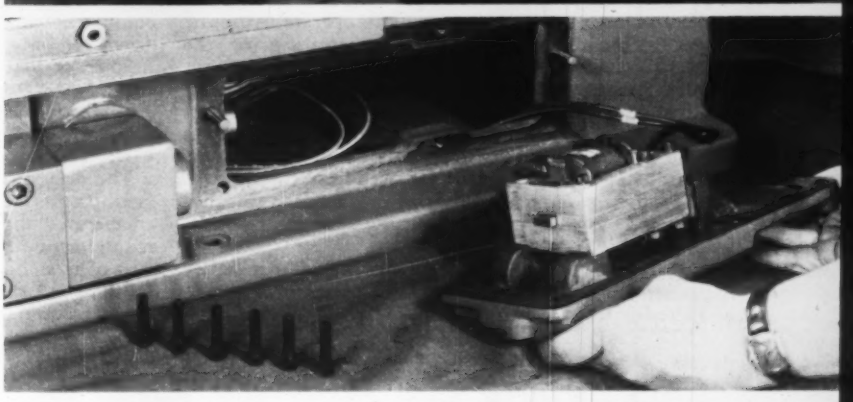


Fig. 7 Maintenance of this solenoid (electrician only) can't delay production long. It's in an oil-tight compartment, and it operates its hydraulic control valve through a pin not physically connected to the valve. Observe that nobody is going to lose the cover that protects this solenoid against contaminants.

locating pins. Since there are sixteen work stations, then sixteen hydraulic cylinders, thirty-two limit switches, and sixteen hydraulic four-way valves would be required.

This design can be simplified by integrating the motion of the racks into one common rack which drives all the pinions for the sixteen sets of locating pins. Two hydraulic cylinders, one on either end, plus their controls of two limit switches and one hydraulic four-way valve, would drive the common rack. By integrating this motion, we have reduced the amount of maintenance required to a fraction of what was needed with individual control.

Similarly, the elimination of oil seals can often be accomplished by use of a labyrinth construction of microfog lubrication in the design; however, there are cases where an oil seal must be used. When this occurs, the design should result in two features. First, it should be possible to replace the oil seal without any major disassembly. Second, the tolerances of the components involved in locating and mounting the oil seal should be such that interchangeability of the seals is achieved (Figs. 3, 4).

Hydraulic cylinders are used for transferring the workpiece, clamping the workpiece, and traversing of heads. The one part which requires the most main-

tenance in a hydraulic cylinder is the packing; therefore, to expedite this type of maintenance, the location of hydraulic cylinders should be carefully analyzed in the design (Figs. 5, 6).

Limit switches are used to give electrical signals so that the next sequenced motion takes place. A special machine requires the use of numerous limit switches. Switches require either electrical or mechanical maintenance and, through poor application or location, this maintenance can be excessive.

A Proper Place for Limit Switches

The placing of limit switches on automation equipment requires ingenuity; when coolant is being used, the location of them is even more critical.

In all cases, the limit switch should be mounted as far as possible from the working area of the machine. Sometimes this will require the use of a separate actuating member, such as a lever. The location of the limit switch in this area fulfills two important criteria. First, the switch is in an area where it can be easily reached for maintenance, and, second, it is not in contact with coolant.

On machines where coolant is being used, the limit switch should be mounted perpendicular to the floor; thus if coolant splash does fall upon the switch, it will flow off. In addition, a permanent type shield around the switch should be incorporated in the design. This permanent shield should not only provide accessibility for servicing, but should also provide protection against abusive wear of the switch. The reason for the permanent shield is that it will not become lost after the first servicing, as is always the case with a removable type shield.

Solenoids are used extensively on machine tools, either to close electrical circuits or to operate hydraulic valves. Both applications require servicing of the solenoid. One aid in maintaining solenoids is to mount them in areas where they are readily accessible, Fig. 7.

Inherent with simplicity of design will be the ease of cleaning. We have found that the simpler our designs are, the greater the chance the machine will be kept clean by maintenance people. Dirt removed from the machine is dirt which will not find its way into mechanisms, hydraulic and electrical systems, causing unnecessary maintenance.

In conjunction with simplicity and interchangeability for controlling down time, we have found the tagging and identification of units to be of great value. Although this information should be on the drawings, we have found that for fast restoration to operating condition it should be on the equipment, too. All limit switches should be identified by number corresponding to the electrical and hydraulic diagrams. All valves should be identified, not only by number, but also by function. Compartments should be adequately tagged. All wires should be identified.

Flexibility Goes Deeper

In reviewing these examples the primary emphasis has been on simplicity and interchangeability. This was necessary because the subject of flexibility, although it was mentioned earlier, generally affects us more in the over-all results of our design rather than in the design problems of a specific component. The machine with flexibility can be used to manufacture the part for which it was designed or tooled, despite any modifications or changes which may be made in that part. It will not become obsolete.

A design can provide this sought feature of flexibility by using what is termed "modular construction," or the building up of a machine using standard modules. Some of these standard modules are the NEMA electric motors, sheaves, and cutting tools. In addition to these already standard modules, the design should incorporate components where the various manufacturers have already duplicated each others' mounting dimensions and space requirements, such as hydraulic cylinders and valves.

Besides this incorporation of standardized modules, the major components in the design should follow the same concept, for this concept provides for part modification with a minimum amount of changing to the machine. This minimum changing not only saves the user of this equipment capital, but also allows the machine to be down for only small periods of time.

Some of the features of this concept are: a standard mounting pattern for various capacity units, standard wing bases, standard columns, standard drilling areas for the various capacity units, standard center bases, standard pallet clamping units.

The design of such a machine (Fig. 8) incorporates flexibility. It contains all the concepts that were enumerated above. It fulfills the automobile industry's requirement for machine tools which will reduce the cost of model changes and shorten change-over periods. In addition, the machine operates at a minimum maintenance cost.

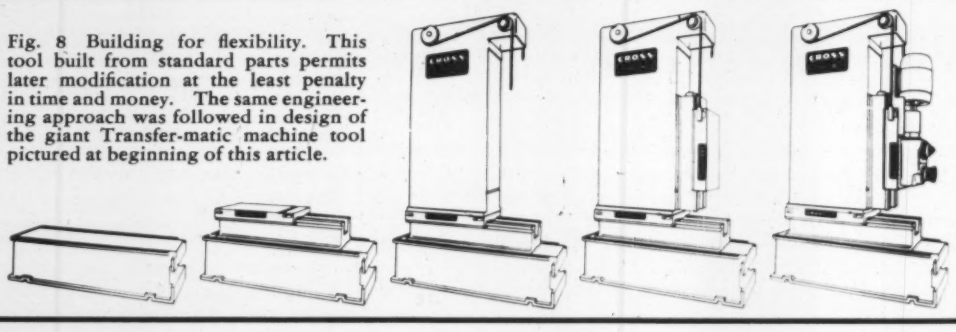


Fig. 8 Building for flexibility. This tool built from standard parts permits later modification at the least penalty in time and money. The same engineering approach was followed in design of the giant Transfer-matic machine tool pictured at beginning of this article.

IMPACT PROTECTION

with Foam Plastics

By E. R. Dye and M. D. Smith

Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y.

Head injuries cause 75 per cent of fatalities in vehicular accidents. Here is the procedure used to select a low-density cellular plastic of the right dimensions and mechanical properties to protect the head in impact.

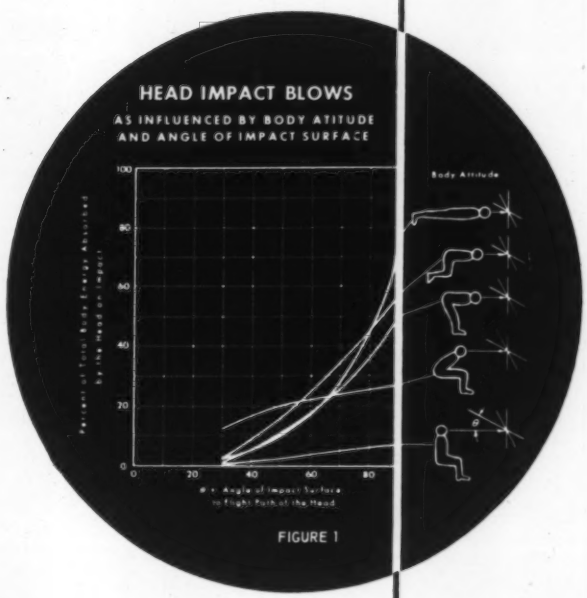


FIGURE 1

In 1948, the Crash Injury Research Group of Cornell University Medical College made an analysis of the type and extent of injuries received in airplane crashes. From this report came the information that about 75 per cent of the fatalities in private airplane crashes resulted from some injury to the human head. This group also collected similar data on automobile accident injuries and reported almost the same ratio of deaths due to head injuries.

Later, the Medical Sciences Division of the Office of Naval Research sponsored a research project at Cornell Aeronautical Laboratory, Inc., to determine the magnitude of head impact blows in airplane cockpits.

The Fracture Level

During this study, the fracture level of the human skull against various objects was determined. For example, it was found that the average human skull would fracture on impact against a hard flat surface at an energy level of 600 in-lb. Medical science research reports that brain damage is likely to occur at a somewhat lower energy level [1].[1] A blow of 400 in-lb on a hard flat surface is commonly used as the critical blow for brain damage. Also from this study came the knowledge that there were four controls to the injury potential of a flat surface:

1 The maximum number of g's that would be experienced by the head on striking the surface ("g" is a gravitational acceleration unit equal to 32.2 fps per sec).

2 Rate of change of g or the rate of onset of the g forces.

3 Peak intensity of pressure on the head in line with the blow.

4 Initial impulse of the head striking an object.

Initial impulse is defined as the product of the mass of the striking headform and the change in velocity of the contact surface of the headform during the period between initial contact and the attainment of a common velocity of the contact surfaces of the headform and the panel.

$$\text{Initial impulse} = M_h(V_2 - V_1)$$

Through our research, we have determined that initial impulse of 5.3 lb per sec is the threshold of fracture [2]

Keep the Rebound Low

From experience gained in our test program, we added to the controls another desirable quality of protective padding; namely, a low rebound. When the rebound is low, there is less energy transmitted back to the head. Also, there is less chance of a second blow occurring on an object or surface which might not be padded.

Of the padding materials tested on the Navy's research program, we found that rigid polystyrene foam having a density of $1\frac{3}{4}$ lb per cu ft provided the best human head protection per inch of thickness. Its low

[1] Numbers in brackets designate References at end of paper.

Based on a paper contributed by the Rubber and Plastics Division and presented at the Semi-Annual Meeting, Detroit, Mich., June 15–19, 1958, of The American Society of Mechanical Engineers.

density allowed its contact surface to accelerate rapidly under low contact force. Therefore the initial impulse remained low. The progressive failure of its cell-like structure limited the peak pressure to about 50 psi until it bottomed at about 70 per cent depression. There was practically no rebound. The structure of the spherical cells was broken down by the impact process; therefore there was little energy stored to cause a rebound.

This type of energy absorber, in which the material "gives its all" to absorb the energy, finds a useful purpose in places where a single impact is expected, such as the airplane panel surfaces mentioned above. However, there are many cases where single-blow protection is not acceptable, such as in protective athletic clothing, helmets, automobile instrument panels, floor cushioning, boxing-ring platforms, etc.

On a project sponsored by the New York State Athletic Commission, work was done in collaboration with the United States Rubber Company's Research Laboratory in Mishawaka, Ind., to develop a cellular plastic material to have about the same impact characteristics as the polystyrene foam. This was the first of a long list of

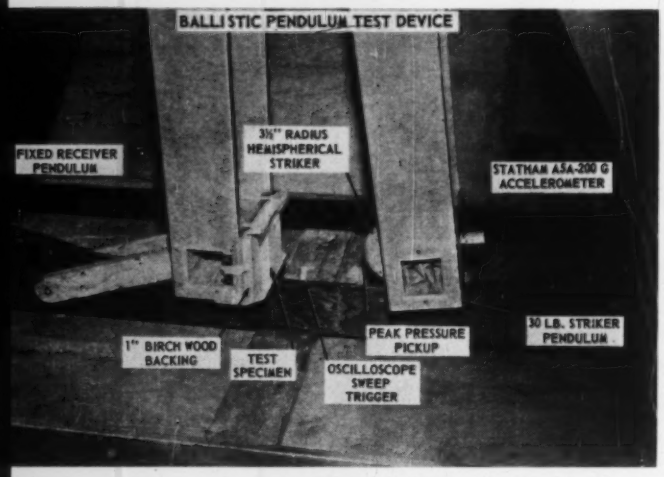


Fig. 2 One device to provide impact energy, a pendulum capable of impact velocity to 12 mph. A solid-wood headform, with gage at center.

low-density foam materials developed to solve a specific energy-absorbing problem. In addition to having important characteristics close to those of the polystyrene foam, it had the advantage of recovering slowly, ready for another blow.

This material, No. 22266 Ensolite, has been used for seven years in the State of New York as the official boxing-ring platform padding material. During a boxing contest, an impact blow to the head from falling to or being knocked to the unpadded mat can be in the order of 1100 in-lb [3]. No serious head injury by contact with the platform has been reported since this material became the official boxing-ring padding. This would tend to indicate that the criteria to which the material was developed were on the safe side for this particular solution.

Thus our approach to the evaluation of mechanical properties of low-density foams as energy absorbers has been one of comparing the properties with those of the $1^3/_4$ lb per cu ft polystyrene rigid foam. This comparison has been based on impact performance using a $3^1/_2$-in. radius headform as a striker. To make the impact of the headform more realistic, we have added additional mass to the head striker to represent the mass contributed by the torso through the neck.

The Simulated Accident

In an accident, both the attitude of the body at the time of a head blow and the angle of the impact surface to the flight path of the head affect the magnitude of the head blow (as measured by the energy of the blow) (Fig. 1). All of the attitudes shown on the right of the chart were photographed during our automobile crash snubbing tests conducted in 1952 [4]. In the tests, a weighted average of the ratio of the energy of the head blow to the total body energy was taken as 1.5, or about 20 per cent. Based on this, we chose 30 lb (20 per cent of 150 lb) as a total weight of the headform and striker.

The comparison of the mechanical properties of low-density foam as head-impact energy absorbers was carried out in the following manner: The basic test device consists of a hemispherical, $3^1/_2$-in-radius, solid-wood headform with a peak pressure measuring device on the center surface of the hemisphere. This pickup is a $^3/_8$-in-diam button attached to a push rod that actuates a strain-gage beam at the base of the hemisphere. The button is flush and is contoured to the $3^1/_2$-in. radius. It has an extremely low deflection system and has a capability of measurements in excess of 2000 psi. In conjunction with this, a 200-g Statham accelerometer has been mounted in line with the striking force to measure the acceleration.

Two devices have been used to provide the impact energy. One unit is a pendulum capable of producing an impact velocity up to 12 mph (Fig. 2) and the other is an air-cylinder propulsion system capable of velocities up to 35 mph (Fig. 3). In all of the tests, recordings have been obtained with either an oscilloscope and Polaroid camera or a recording oscillograph.

Impact Test Data

The following information was recorded for each blow: velocity of striker, deceleration of striker versus time, and peak intensity of pressure on the headform in line with the blow. Rate of change of g was measured from the plotted g versus time curve. The controls here established in developing padding for head-impact protection are:

Maximum $g = 60$.

Maximum rate of change of $g = 20{,}000$ g per sec.

Maximum intensity of pressure in line with the blow = 600 psi (approximately the pressure that would be experienced on a flat unpadded sheet of 0.020-in. steel, such as an instrument panel).

Impact test data are shown for polystyrene foam having a density of $1^3/_4$ lb per cu ft (Fig. 4). When used on a flat rigid surface, the 1-in. thickness of polystyrene foam would provide safe values up to about 10 mph. The 2-in. thickness is satisfactory up to about 12 mph.

Later, instrument panels covered with low-density

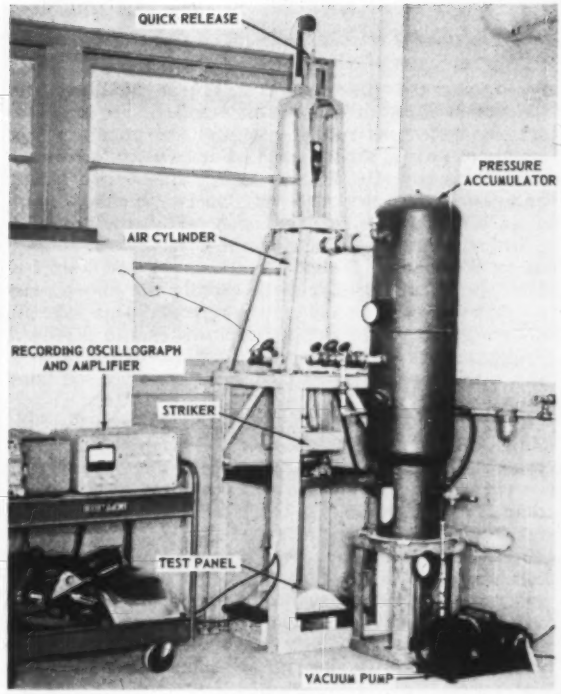


Fig. 3 Air-cylinder propulsion system which can bring the striker to 35 mph. Recordings were either by oscilloscope and Polaroid camera, or made by a recording oscillograph.

foams and other types of padding materials were tested. In most cases, the metal panels absorbed a large part of the impact energy. All padding materials became more effective when used on a low-weight, yielding foundation such as a thin gage steel, aluminum, or plastic instrument panel. We have found no way to correlate the value of data taken on a rigid backing to that of padding on a yielding platform. They must be tested in combination to determine the combined properties [5].

What the Tests Show

Here are general conclusions from this program:

1 Most of the energy-absorbing plastic foams do not have linear spring rate characteristics under impact blows. Therefore they do not lend themselves to a simple mathematical analysis.

2 The better energy-absorbing foams resist impact with nearly constant pressure for approximately three quarters of their thickness.

3 Dynamic pressure characteristics cannot be determined by static compression tests.

4 Different formulations of plastic foams that have the same density and rigidity do not necessarily have the same energy-absorbing characteristics.

5 The mechanical characteristics of most low-density foams when used as energy absorbers change greatly with the temperature. They tend to get stiffer as the temperature drops.

6 In cases where the impact energy exceeds the energy-absorbing capacity of the foam and an auxiliary absorbing structure is used (such as a sheet-metal panel to back up the padding), a covering of plastic foam produces a large reduction in the peak pressure experienced by the striking object and also distributes the force over a larger surface area by "dishpanning" the panel (Fig. 5.). It will be noted that back-up panels having a radius of curvature greater than 2 in. exhibit similar characteristics to those of a flat panel.

The same general procedure has been used in other problems of delicate objects. First, the limiting controls of the object to be protected are determined (deceleration limits, rate of deceleration, critical distribution of forces, etc.). Then, the object, or a reasonable facsimile (weight, shape, and flexibility), can be instrumented and tested to determine the suitable combination of thickness and mechanical properties of the energy absorber.

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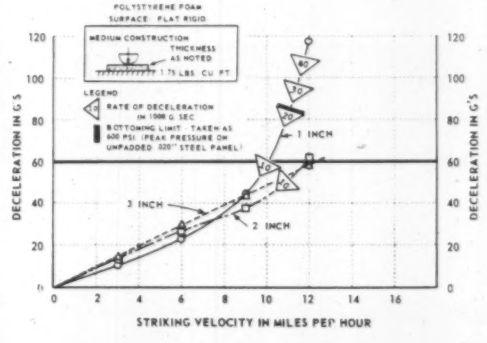
POLYSTYRENE FOAM SURFACE - FLAT RIGID
MEDIUM CONSTRUCTION
THICKNESS AS NOTED
1.75 LBS. CU. FT.
LEGEND
RATE OF DECELERATION IN 1000 G SEC.
BOTTOMING LIMIT - TAKEN AS 600 PSI PEAK PRESSURE ON UNPADDED .020" STEEL PANEL
1 INCH
2 INCH
3 INCH
DECELERATION IN G'S
STRIKING VELOCITY IN MILES PER HOUR

Fig. 4 Design data for crash safety: polystyrene foam, density 1¾ lb per cu ft. Deceleration in 1000 *g* per sec. Heavy line marks the point where bottoming occurs.

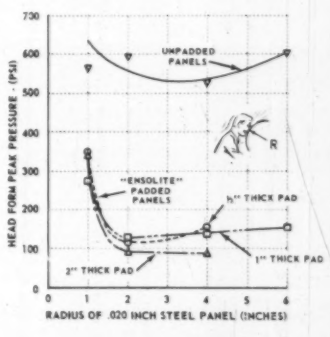

Fig. 5 Sheet metal panels, with and without plastic-foam padding. If radius of back-up panel drops below 2 in., effectiveness of padding-and-panel combination is greatly reduced.

ENGINEERING INFORMATION

All is not lost!

By R. H. Phelps

Director, Engineering Societies Library, New York, N. Y

Through the activities of the Engineering co-ordinated services unmatched elsewhere in the

More or less continually, one is confronted with statements that the recent growth of the scientific and technical literature has been so great that its use is impracticable, if not impossible. In a general sense this idea goes back to the Old Testament which says "Of making many books there is no end" [1].[1] In the 1890's, when the Royal Society of London was contemplating the publication of "The International Catalogue of Scientific Literature" [2], the increasing amount of the literature and the difficulty of its use were deplored.

The Soviet Challenge

Another topic since the advent of the Sputniks is the extent and excellence of Soviet abstracting services—often with the implication, if not the statement, that abstracting and indexing services in the United States are inferior. It is not the intention, here, to depreciate the Soviet abstracting services; they are impressive, if for no other reason than because they have grown so rapidly since they were started in 1952. Because the work is centralized and many literature scientists work in one place, it is physically an impressive operation. In the U. S., abstracting and indexing services are generally not governmental operations and are scattered throughout the country.

If the Soviets have profited more than we have from the technical literature, one may believe that they have worked harder at using it. The Soviet centralized information services are not essentially better than the services available in this country. Some of the larger sections of the Soviet abstract services have no subject indexes and are therefore very difficult to use.

Over here, mechanization is being studied as a means of reducing the time and cost of the handling and retrieval of literature. For small collections of literature in restricted subject fields, mechanization has sometimes proved satisfactory. For large collections in broad fields covering diverse subject material including concepts as well as materials, mechanization is apparently many years away. Its current status and some of its many problems and difficulties have been pointed out by Warheit [3], Taube [4], Shaw [5], and Rabinow [6]. The over-all problems of getting the information ready for the machine and getting it from the machine are perhaps greater than the development of the machine. Machines work best on repetitive and routine operations. Such operations are not common in literature handling and retrieval.

Everyone wishes that the literature could be searched more quickly and at less cost. Efficient mechanized systems for large collections are not now available—not even at the very high prices charged for the large computers, which are now being promoted for literature search work despite the fact that they were designed for other work and are not particularly efficient as literature searching tools [4].

Despite all this, the technical literature can be and is being effectively used. Our present abstracting and indexing systems may not be all that their publishers or users would wish them to be; but none of the many abstracting and indexing services available in the Engineering Societies Library is years behind, as was stated by a witness at a recent Senate Committee hearing [7].

The witness gave the impression that literature searches generally take a great amount of time (he mentioned 6 months as one example) and that searches cost from $1000 to $100,000 and even more. He also stated that "the little man is out." The Engineering Societies Library makes many literature searches each year for fees under $100 to under $1000. These are not complete literature searches and they may not deal with the largest and the most complex problems, but how often does "the little man" or anyone else deal with these? Letters of commendation, and additional orders from those who have used the services of the Library, attest to the value of these inexpensive literature searches.

The Library: Its Background

The Engineering Societies Library was established in 1913 through the merging of the long-established libraries of the American Society of Civil Engineers, the American Institute of Mining, Metallurgical, and Petroleum Engineers, The American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

The Library is outstanding in its coverage of the fields of civil, electrical, mechanical, mining, metallurgical, and petroleum engineering. It also extensively covers chemical engineering and all other branches of engineering, primarily in the level of the graduate and practicing engineer. The Library contains over 175,000 volumes, 20,000 maps, 5000 translations, and 10,000 bibliographies and indexes. Some 1500 periodicals are currently received from all parts of the world; about

[1] Numbers in brackets designate References at end of paper.

Contributed by the Power Division and presented at the Annual Meeting, New York, N. Y., Nov. 30–Dec. 5, 1958, of The American Society of Mechanical Engineers. Paper No. 58—A-178.

Societies Library and the Engineering Index, engineers have a unique documentation center and world. Here is how assembling, filing, and locating of engineering information are accomplished.

one third of these are in foreign languages. Recently the coverage of Russian and other Eastern European scientific and technical publications has been expanded, and important publications are continually added.

In addition to collecting extensively, but selectively, engineering publications of all types on a world-wide basis, the Engineering Societies Library maintains complete files of all technical publications and papers of ASME and of the other Founder Societies. Its collection of their unpublished papers is particularly important, for most of them are manuscript copies not elsewhere available, not even in the Societies' own files.

After stocks of their publications are exhausted, the Founder Societies refer inquirers to the Engineering Societies Library for photoprint or microfilm copies. Often this is done simply by transferring the inquirer's letter or order directly to the Library. We believe that this practice is the best way to serve with the least possible delay.

Each issue of MECHANICAL ENGINEERING contains a list of "Books Received in the Library." These are some of the over 600 brief book reviews prepared each year for the journals of the Founder Societies so that members may learn about new books in their field. Most of these books, as well as others in the Library, may be borrowed by members of ASME and of the other Founder Societies.

The services of the Engineering Societies Library also include a reading room open six days and five nights a week for most of the year. It is staffed by persons having library and technical training.

Literature Searches

Thousands of requests from members for brief information which can readily be located are answered without a charge. For members and others requiring extensive information, literature searches and bibliographies are made, for a fee, to the specific requirements of the inquirer. The service ranges from recommending books on a specific subject to the preparation of comprehensive annotated bibliographies of books, articles, and reports. Searches are also made for disclosures related to patents. All search work is kept confidential.

The Library's staff also prepares bibliographies on subjects of general engineering interest. These may be purchased by anyone. A list is available on request.

Translations of engineering and technical articles are made from all languages into English by "consultant" translators who are familiar with engineering. All translations are reviewed by a member of the staff of the Library to insure accuracy of translation and the quality of the English.

Photoprint and microfilm copies of the material in the Library are made on request.

All of the foregoing services, except loans of books to members, are available to anyone. They are used by engineers, scientists, technologists, and industry in this country and throughout the world. More than half of the users of the Engineering Societies Library do not come to the Library but use it by mail, telephone, and telegraph.

Joint ownership and support of the Engineering Societies Library by the Founder Societies is achieved through the United Engineering Trustees, Inc., an organization established by the Founder Societies to own and operate the Engineering Building. The Library is a department of the UET, as is also the Engineering Foundation.

The Engineering Index

The Engineering Index, now in its 74th year, is an internationally accepted digest of technological literature prepared for engineers, research workers, and students. The Index and the Library, although separate organizations, co-operate closely. All publications received by the Library are made available to the Engineering Index, which is housed in the same building. Through the Index, the Library has a ready-made published index to articles in periodicals and other publications in the Library. This unique arrangement is of great value to engineers and industry.

The Engineering Index reviews 1400 leading periodicals and society transactions, as well as a substantial number of bulletins and reports of government bureaus, research laboratories, technological institutes and colleges, and other agencies. Last year the service provided annotated references to 27,000 articles. The Index issues a weekly card service in 255 subject divisions. Subscriptions may be placed for single subject divisions, for groups of divisions, or the entire card service. The cost of the divisions ranges from $12.00 to $45.00 each, with a total cost of $1500 for the complete card service. Educational institutions receive a discount. The Index subsequently appears as a bound volume[2] cumulating all of the references for the year. The charge for this bound volume is $70.00.

New Facilities

Looking to the future, the co-operative information activities of the Engineering Societies, the Library, and the Index will continue to grow. The American Institute of Chemical Engineers has recently become the fifth Founder Society. It is expected that other societies will join in the support of the Library when the Societies move into the new United Engineering Center to be erected near the United Nations in New York City. The better facilities and the broadening base of support and interest should lead to increased and better information services for the engineering profession.

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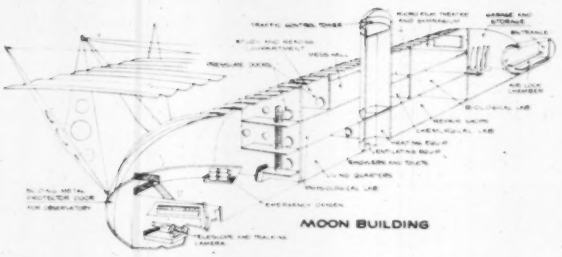
Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

BRIEFING THE RECORD

Engineering for the Moon



ENGINEERS who find the complications of stress, corrosion, and temperature problems a little wearing at times, would do well not to become involved in the problems of designing structures for the moon.

In the first place, any structure erected on the moon must be prepared for a constant bombardment of particulate matter at velocities from 1.5 to about 44 miles per sec, and ranging in size from dust to good-sized meteorites. Since there is no atmosphere, even the smallest of these will reach the surface unconsumed.

Second, gravity is only $^1/_6$ as strong as on earth, causing construction workers and equipment to behave rather strangely. Workmen who do become accustomed to weighing only $^1/_6$ as much as usual will need protection from the intense light and ultraviolet radiation of the sun. They will also have to become as accustomed as submarine crews to accommodating themselves to changes in pressure, passing through air locks, and carrying their own atmosphere with them when they venture out of their protective quarters.

To begin the design of a structure for the moon, the engineer must first assume that the surface of the moon will act as a fluid of low density—since some informed opinion holds that the surface is a sea of dust particles. If this is true, the building must float as it would on a windless sea.

No consideration has to be given to wind or snow loads, but the major stresses will be from the pressure of the artificial atmosphere contained within the hermetically sealed building. Probably the 10 psi used for the cabins of high-flying aircraft would be chosen, although this is less than the 14.7 psi of the normal atmosphere.

The decreased gravitation also means that the deflection of any load-supporting beam or column would be only $^1/_6$ as great as it would be on earth. Ordinary materials thus become exceedingly high-strength lightweight construction components. Ramps and stairs could be steeper, but elevators would require different considerations because of the acceleration and deceleration of masses rather than weight.

Lunar temperatures, which range from 214 F at midday to 32 F at sunset and −243 F at midnight of a two-week-long day and two-week-long night further complicate stress and heating problems.

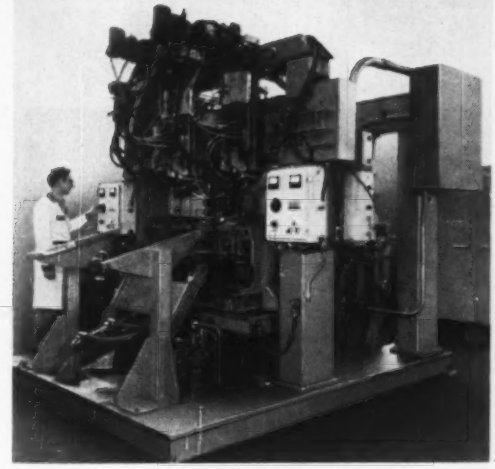
Plastic observation bubbles would have to be protected with metal shutters and opened only occasionally because of the discoloration of the plastic from the intense ultraviolet rays.

Building and transporting the 50 to 75 missiles required to carry the construction materials to the moon would be no small problem in itself.

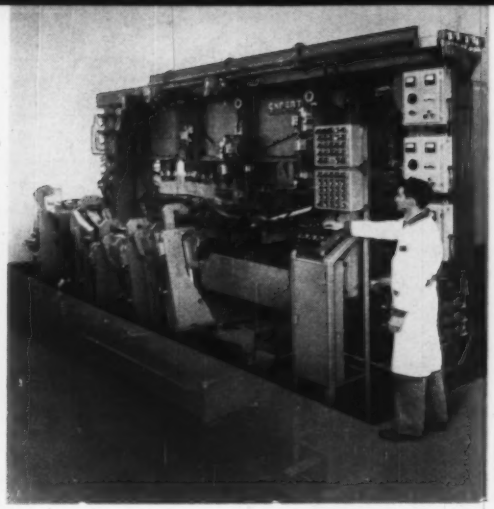
With these complications in mind, Wonder Building Corporation of America, Chicago, Ill., has formulated plans for a permanent "moon building" to serve as living quarters and provide space for research laboratories, maintenance shops for space vehicles, and earth-moon communication facilities.

John S. Rinehart, professor of mining engineering, Colorado School of Mines, and former associate director of the Smithsonian Astrophysical Observatory, Cambridge, Mass., gave technical direction to the design and engineering of the structure. A detailed 5 × 6-ft-scale model of the structure and the data accumulated in its planning have been presented to the National Aeronautics and Space Administration as a contribution to space-age research—and, possibly, with an eye to publicity.

A pressurized building engineered for construction on the moon could "float" on a sea of dust



Continuous-contour automated Expert welding machine that automatically welds the contours of automobile-frame siderails by means of a unique Expert magnetic-tape-tracer system. The machine when installed sits in a pit approximately 30 in. deep.



The Expert automated welding machine also incorporates the Expert magnetic-tape-tracer system and contour-welds two channel half sections together to produce completely and accurately welded automotive-frame cross-member

Magnetic-Tape-Tracer Welding

A NEW magnetic-tape-tracer welding system that permits the joining of metal parts having untrimmed, out-of-tolerance, straight-line, or contour-weld-line edges in a continuous automated welding operation has been developed by Expert Welding Machine Division, Expert Die and Tool Company, Detroit, Mich.

This system controls self-powered welding heads which automatically follow any type welding contour with a high degree of accuracy by having the basic welding-head carriage follow the proposed design contour of the part weld line. A mechanical probe mounted through a slide on the welding-head carriage follows the actual weld contour line. The movements of the slides are transmitted into a differential whose output then represents the error between the actual and design weld line.

This displacement error is then recorded on a loop of magnetic tape where it is temporarily stored. A reading head, located on the same tape loop a few inches behind the recording head, picks up this error intelligence and feeds it through a simple amplifier and hydraulic valve to a hydraulic servocylinder. The servocylinder corrects head position with respect to the welding carriage to correct for the reported error.

The probe is positioned a few inches ahead of the welding head to eliminate weld-splatter deposits on the probe. The distance between the probe and the welding head is equivalent in time units to the distance between the recording and reading heads.

Looped tape eliminates rewinding operations and an erasing head is included. Tape life is many thousands of operations.

Machines built thus far have used the CO_2 arc-welding process. The system is equally adaptable to submerged-arc, sigma-welding, and other processes.

This new electronic-tracer welding system has been used for automated production-welding operations on parts such as automotive wheels, frame siderail, and cross-members.

The frame-siderail welding machine is a four-post structure with a fixed upper crown straddling a work-holding platen in the welding station. The entire mechanism and basic contour cams for driving and partially guiding the welding heads are mounted on the upper crown. Each welding head is supported by a carriage. All carriages are identical units independently driven by separate motors. These motors power the carriages through a rack-and-pinion mechanism.

Each carriage-supported welding head is guided by cam rollers which follow the basic part-contour cams. These are made to print dimensions. Cams totally guide the welding heads in the horizontal direction and partially in the vertical direction.

The Expert magnetic-tape-tracer system compensates for any deviation from the contour cams which may be as much as $\pm 3/16$ in., taking over and correctly positioning the welding torch on the welding line.

The work-holding platen in the welding station contains a family of air-operated clamps which provide nominally continuous side-clamping pressure below the weld line along the entire length of the part and are also adjustable to compensate for springback of the part and for any wear conditions.

Manual loading into an assembly station at the front of the machine begins operation and two channel halves are then press-assembled with power air clamps.

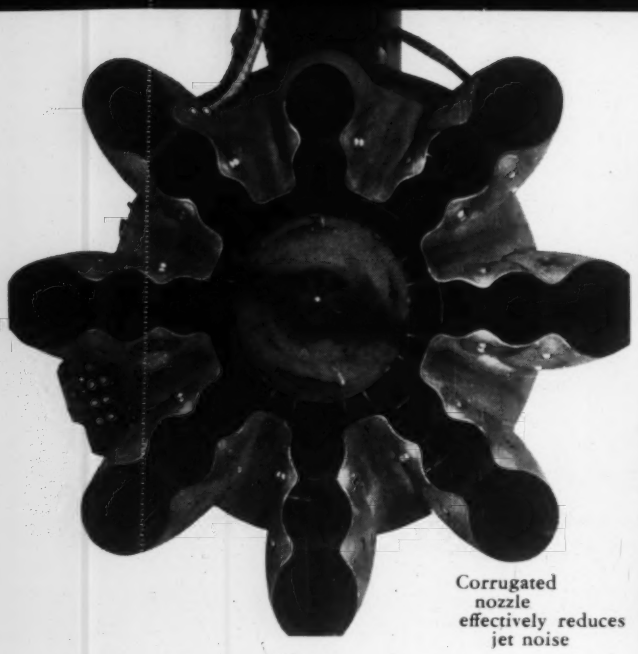
The assembled siderails are then automatically transferred to the welding station and then onto an unload station by means of a hydraulically operated walking-beam transfer mechanism operated by hydraulic cylinders. The cylinders raise the transfer mechanism by means of a bell crank-type linkage and move it, together with the rails, into the three-dimensional contour-welding station and unload stations in the machine.

After welding operations are completed, the clamps are automatically released and the platen is automatically lowered to permit the next transfer operation.

The operation and design of the cross-member welding machine are essentially the same as the siderail welding machine with a few exceptions.

Because the cross-member channel halves to be welded are shorter than the siderails, only four welding heads instead of the six required in the other machine are used to weld the channel halves together to produce finished frame cross-member parts.

After manual loading, the parts are clamped in position, overhead rams move down and press-assemble the two channel halves. Other operations are similar.



Corrugated nozzle effectively reduces jet noise

Acceptable Jet Noise

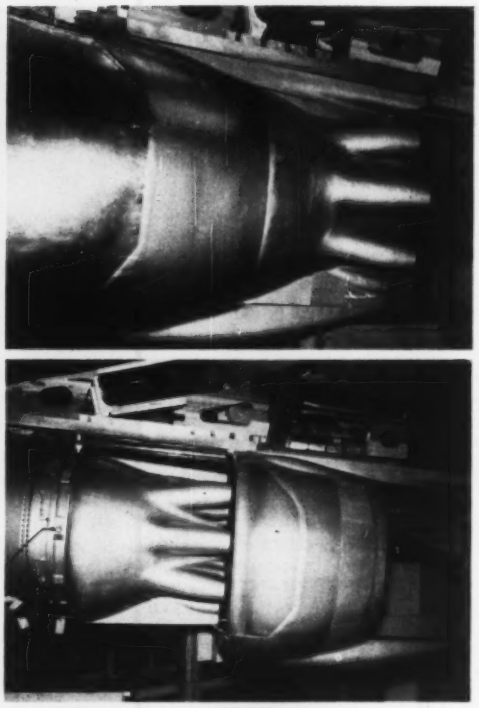
A DEVICE which reduces the sound of jet engines to acceptable levels without loss of power and also shortens the landing roll of a big jet transport has resulted from a 3-yr development effort at Douglas Aircraft Company, Inc., Santa Monica, Calif. Details were given in a paper presented at the National Aeronautic Meeting of the Society of Automotive Engineers by company engineers L. R. Jordon and C. M. Auble.

When the project was started, the company set goals of 9 to 12-decibel sound reduction and the equivalent of at least 40 per cent of full power in reverse thrust. The device now in production for the DC-8 jetliner, the paper reports, "meets or exceeds the performance objectives originally set up."

The investigation involved considerable experimentation with nozzles of various shapes attached to the jet outlet to hasten the mixing of exhaust with outside air. Quicker mixing is one way of reducing the sound level; but altering the shape of the outlet reduces the engine power. Any protuberance also increases drag of the airplane.

When mixing nozzles were supplemented with a device called an "ejector"—a cylinder extended beyond the exhaust nozzle during take-off—the sound decreased 3 to 4 decibels and take-off thrust increased sufficiently to offset the loss caused by the nozzle. The combination of a corrugated nozzle and the ejector cylinder effected the desired amount of noise reduction.

In selecting a thrust-brake design, the Douglas engineers found the most logical type was the "target" type, consisting of contoured doors mounted behind the exhaust nozzle to turn the exhaust forward. These doors are built into the ejector cylinder, normally lying flush with the sides, and closing when braking is desired.



Side views of the sound suppressor and thrust brake, *above*, in the normal flight position with the "ejector" retracted to form part of the engine pod; and, *below*, in take-off position for the most effective reduction of noise. Oval indentation in the ejector is one of the two doors which close to form a thrust brake and reduce landing roll.

Instantaneous Heat

THE A. F. Holden Company, Detroit, Mich., has perfected a luminous-wall firing or "instantaneous-heat" system which is a combination combustion system and heating mechanism that transfers controlled heat with great rapidity and uniformity through metal structures. It provides a positive source of transferring heat by radiation directly to work processed with negligible thermal storage in the furnace structure. This feature of the system results in the unique combination of rapid starting, rapid cooling, and rapid restarting.

During a recent test a solid 2-in. cylinder of iron, 6 in. long, was heated from 80 F to 2000 F in less than 20 min and was cooled back down to 1000 F in 16 min while still in the furnace by means of controlled, continuous air flow through the porous refractory lining.

The more important advantages are: (*a*) 40 per cent less fuel required during any average day; (*b*) temperatures of 1000 to 2000 F are obtained within a 1 to 10-min time cycle using 50,000 Btu's per sq ft; (*c*) furnace can be rapidly cooled without refractory spalling; (*d*) longer refractory life expectancy.

Used in a wide range up to 2300 F, the combustion system is particularly applicable in a variety of specialized application areas where speed and uniformity of heating are important, such as: Hardening various steel specimens, increment heating for pointing pipes before redraw, stress relieving of boiler tube ends, changing grain size of stainless-steel assemblies, heating large pipe sizes for T-extrusions.

Looking to the future, Holden engineers visualize further applications of the luminous-wall firing system to processing special alloys used in high-altitude aircraft and missiles and varied uses in the petroleum and textile fields.

Self-Sustained Turboprop

GRUMMAN's twin turboprop Gulfstream, a newly developed executive transport, enjoys an unrestricted flexibility of operations and freedom from outside support by carrying its own source of auxiliary power —an AiResearch small gas-turbine engine—to start main engines and provide atmosphere conditioning on the ground.

The plane is thus independent of ground support normally needed by jets and found only at large, key terminals. It can therefore land and take off at smaller airports not equipped to handle jet aircraft.

The gas-turbine engine, manufactured by The Garrett Corporation's AiResearch Manufacturing Division of Arizona, generates ample power to start the Gulfstream's engines and also provides air conditioning on the ground at any airport where it may choose to land.

Improved Lubrication

SOUTHWEST RESEARCH INSTITUTE (SwRI) has announced a decided gain in the ability of lubricants to provide lubrication for high-speed gears in an atmosphere from which air has been removed. This finding was made in a research program on the lubrication requirements of missiles and space vehicles conducted at SwRI under Air Force sponsorship.

It was found that a straight mineral oil, as well as the same mineral oil fortified with three different "extreme-pressure" additives, all exhibited decided increases in "gear load-carrying capacity"—a factor important in keeping gear weight to a minimum when aircraft weight is considered—if the gears were operated in an atmosphere filled with nitrogen or argon, instead of air. The three extreme-pressure additives used represent, respectively, a phosphorus-type, a sulfur-type, and a chlorine-type additive. The results obtained to date show that, with the air removed from the system, the load-carrying capacity was approximately doubled. Whether this same effect applies to other types of lubricant is not yet known. Work is now in progress in tests on typical synthetic lubricants.

Automated Railroad Classification Yard

ULTIMATE AUTOMATION of railroad classification yards with resultant lessening of damage to freight shipments was predicted by R. J. Berti, Union Pacific Railroad, Omaha, Neb., and T. J. Dosch, Reeves Instrument Company, Garden City, N. Y., in a paper, "An Automatic Speed Control System for a Gravity Freight Classification Yard," prepared for presentation at the Fall General Meeting of the American Institute of Electrical Engineers in Pittsburgh, Pa.

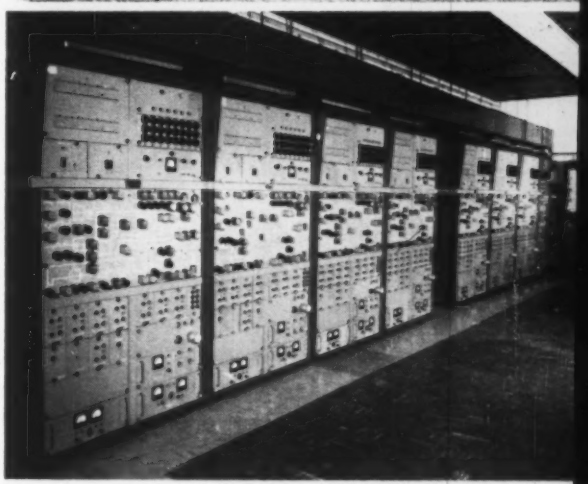
Damage to freight shipments has been steadily increasing in recent years, costing United States railroads $100 million annually. A control system which minimizes the force of freight-car coupling has been developed and is now being used in yards of the Union Pacific at North Platte, Neb., and the Atlanta, Ga., yards of the Southern Railway Company.

The system utilizes a computer which determines the acceleration of each car on a tangent track of known slope. The cars pass through this "acceleration-measuring section" of track before entering the group retarder. The computer determines the speed at which each car should leave the group retarder in order to couple properly. A closed loop then controls each car to this computed speed as it passes through the group retarder. The system also includes a switching machine for the automatic routing of cars.

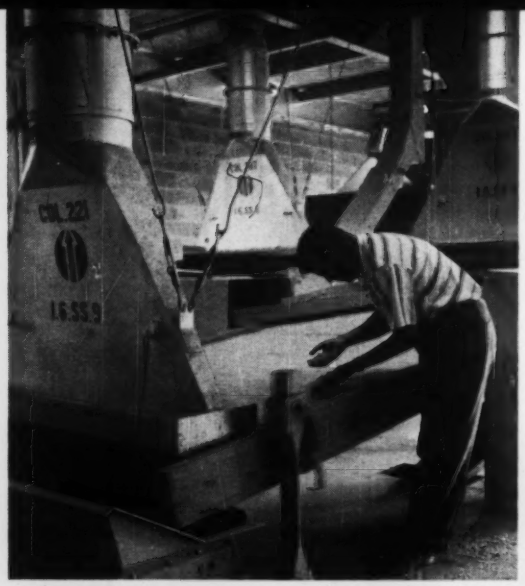
A remote-controlled accelerator, designed to move railroad cars stalled while being "humped" in classification yards, was also described in a land-transportation symposium.

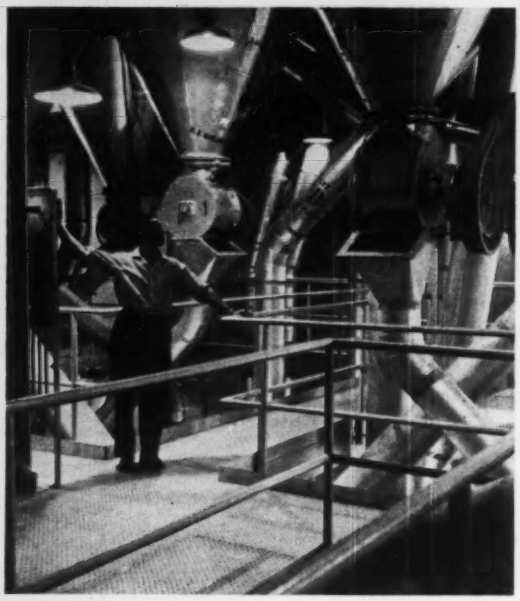
The accelerator, which is $18\frac{1}{2}$ ft long and 6 ft 8 in. wide, exerts a pushing force of 4000 lb at $3\frac{1}{2}$ mph on a level track. It is powered by 56-cell, 500 amp-hr lead-acid batteries, and is remotely controlled by the tower operator, according to J. D. Hughson of the General Railway Signal Company, Rochester, N. Y.

Speed of freight cars is continuously monitored by doppler-type radar. Indicated speed is compared continuously with the programmed speed. In the UP yard, pneumatically operated retarders have a time constant of approximately 1.5 sec. Position feedback from a pressure-voltage transducer connected into the retarder air chambers acts to linearize the on-off response.



All of the components that comprise the velocity head a car should have at the exit of the group retarder are automatically summed in the control room. A program speed is computed which is made equal to the car's speed at the entrance to the retarder, and is gradually reduced until it is equal to the desired exit velocity when the car leaves the retarder.





Ore from the bed of drained 500-acre Black Lake, Quebec, produces 100,000 tons of asbestos fiber a year. Cone-shaped cyclone separators in the $9.2-million mill, *lower photo,* produces clean fluffy fiber from the asbestos after it has been "floated off the rock" by the "vacuum cleaners," *upper photo.* About 980,000 cfm of air are required by the extensive air-blowing equipment in the ultramodern mill.

New Asbestos Mine and Mill

Moving 500-acre Black Lake (Quebec, Canada) into new man-created basins; shifting the Becancour River (which once flowed in and out of the lake) into new, wider channels; construction of four dams; and the building of a new highway to replace the road around the lake were the gigantic tasks necessary to provide access to a rich asbestos deposit contained beneath the mud, silt, and rock lake bottom.

This feat was accomplished by Lake Asbestos of Quebec, Ltd., a wholly owned subsidiary of American Smelting and Refining Company, following explorations by United Asbestos Corporation, Ltd., which confirmed existence of a rich vein of asbestos ore under the lake.

On this site now stands an ultramodern asbestos mine and mill. Total cost: $36,000,000.

The operation will contribute a 7 per cent increase to the free world's supply of asbestos fiber. Mining operations at the site are expected to yield 100,000 tons of asbestos a year for at least 20 years, from open-pit mining; after that, underground mining will probably be necessary.

Asbestos mining is one of the major industries of Quebec, and asbestos is one of Canada's principal exports. Executives of Lake Asbestos of Quebec, Ltd., during recent dedication ceremonies, outlined the importance of asbestos to modern technology. The mineral fiber is used in such varied products as refrigerators, building materials, brake linings, conveyer belts, fire-protection clothing, gaskets, and steam pipes. A significant application is the fabrication of missile nose cones, where asbestos fiber plays an essential role.

The Black Lake installation features a new mill which cost more than $9 million. As tall as a 14-story building, the mill houses ultramodern equipment to free asbestos fiber from the ore and to grade, dry, and prepare fiber for shipment to processors of asbestos materials throughout the world. There are also special buildings for the crushing of the ore as mined and for the storage of ore during the various phases of processing. A network of conveyers links the buildings, and many operations are guided by electronic remote-control systems. Built to serve the mine and mill are an electric substation, repair shops, garages, offices, and railway spur.

Shakedown operations at the mine and mill started in late summer. The mill is now operating on a full commercial scale.

England-France D-C Cable

ELECTRICITY will begin to flow under the English Channel between France and England, via a d-c interconnection, in time to meet the winter peak of 1960–1961, according to François M. Cahen and Roger A. Tellier, of Electricité de France, in a paper prepared for presentation at the Fall General Meeting of the AIEE in Pittsburgh, Pa.

The power finally adopted, taking the possibilities of mercury-vapor valves into account, is 160 mw under 200 kv, the middle point of the transmission being earthed.

The cables will be laid between Dugness and Le Portel, a distance of some 32 miles, and will connect the British 275-kv and the French 225-kv systems so that both countries can exchange power.

Metals Development

NUCLEAR METALS, INC., recently completed a $2-million plant at Concord, Mass. An outgrowth of the M.I.T. Metallurgical Project which was a facility of the Manhattan District, the concern engages in contractual research and development for government and industry, particularly in metals for nuclear and space-vehicle applications. It continued under M.I.T. auspices until 1954, when Arthur D. Little, Inc., and Allegheny Ludlum Steel Corporation were selected by the Atomic Energy Commission to continue the activities of the Metallurgical Project and formed the present company.

The facilities are adequate for the development of a metal from basic research to fabrication, machining, and—more recently—pilot-plant production. The widespread use of zirconium in the nuclear field can largely be credited to the firm and its predecessor. In addition to the continuing work on uranium, beryllium is receiving major attention, and Nuclear Metals, Inc., has successfully extruded tungsten.

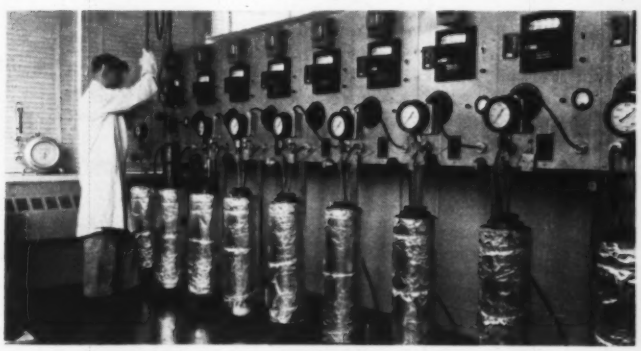
The research and development efforts are grouped into three major departments: Mechanical metallurgy, metallurgical research and development, and technical services. Metallurgical research and development consist of groups in chemical metallurgy, physical metallurgy, and fundamental research.

The mechanical metallurgy department consists of an engineering-metallurgy group, a materials-fabrication group, a foundry group, machine and welding shops.

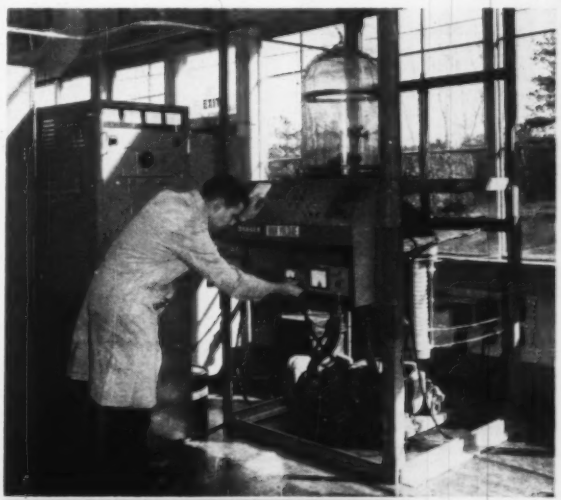
The radioactive or toxic nature of the materials handled requires elaborate shielding, ventilation, chip-recovery, and waste-disposal systems, and a five-man safety group, although only about 200 are employed.

Most melting is done in water-cooled induction-heated vacuum furnaces. Drip melting, a variation of zone refining, melts a drop at a time in a vacuum and is used where extremely high purity is required. Electron-beam welding—pioneered in this country by the Hanford Works—is used for welding in a vacuum. Stress-rupture furnaces are capable of testing up to 2300 F.

Coextrusion of tungsten clad with platinum and stainless-clad molybdenum has been developed, including coextruded parts which have integral closures to completely seal the core material from an outside environment. Several types of nuclear fuel elements are being manufactured in prototype—notably for the fast-breeder Enrico Fermi Reactor, Argonne's CP-5, and also the S3G submarine reactor. Intermetallic compounds and material and design problems for nose-cone re-entry are also being studied.



Autoclaves, *above*, are lowered into furnaces to check corrosion resistance, in high-temperature, high-pressure water and steam, of Zircaloy cladding materials used for nuclear fuel elements and other reactor components



Drip melting, *right*, a variation of zone refining, produces refractory alloys of ultrahigh purity. An electric arc is used in a protective atmosphere.

Metals are welded, *above*, in a vacuum with an electron gun which focuses a stream of electrons onto the workpiece

Rotary-Screw Air Compressors

ATLAS COPCO has completed a 2-yr series of exhaustive field tests, and, on the basis of operating experience, has announced full production of space-saving, positive-displacement rotary-screw air compressors delivering up to 19,250 cfm of air.

The twin-rotor two-stage compressors develop four complete compression cycles per revolution and operate at speeds of 3600 rpm. They will be made available to U. S. industry in 6700, 10,000, and 19,250-cfm models, bringing rotary-screw compressor economy to major industry. Earlier models of rotary-screw machines had limited industrial value because of their relatively small air capacities.

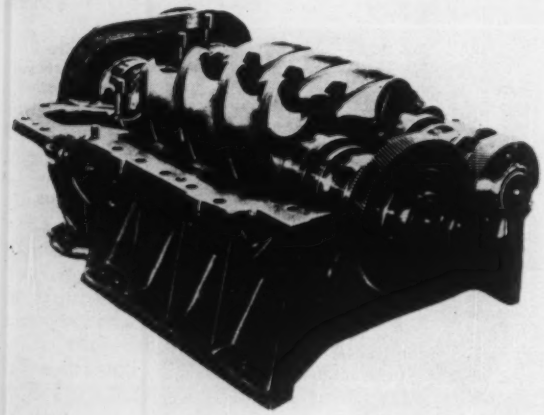
The machines offer substantial maintenance savings because their rotors do not quite contact each other during their high-speed spiral-like operations. Besides reducing component wear, this design alleviates the need for antifriction lubricants, assuring a flow of completely oil-free air or gas.

The only parts subject to wear during normal rotary-screw compressor operation are the bearings and gears on the shaft journals, and this wear is minimal. In standard piston-type machines, however, the valves, cylinders, and pistons all are subject to wear and may require frequent servicing or replacement. In rotary-vane-type compressors, the vanes also are liable to wear.

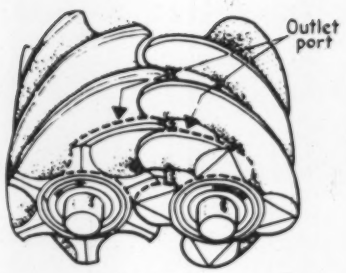
In operation, the compressor draws air into the front end of its twin-screw assembly. As the large threads or lobes of the parallel-mounted screws rotate into each other's grooves at high speed, air is spiraled ahead into increasingly small interlobe volumes until it is forced through the discharge port at pressures ranging up to 120 psi.

Design of the "Twin-Air" Atlas Copco rotary-screw compressor has evolved over the past several years from pioneering studies of this specialized compression principle by A. Lysholm, Mem. ASME, professor at the Royal Institute of Technology, Stockholm, Sweden, initiated in 1934. Further developmental work has been done during the last decade by Svenska Rotormaskiner AB of Sweden. Atlas Copco is licensee under their patents.

Positive-displacement rotary-screw air compressors reduce component wear and alleviate the need for antifriction lubricants, assuring oil-free air or gas



Compression cycle of the rotary-screw air compressor shown in four stages



Missile Miscellany

▶500,000-Hp X-15 Rocket Engine

THE PIONEER, an advanced-design large liquid-propellant rocket engine being produced by Thiokol's Reaction Motors Division, Denville, N. J., for the X-15 research aircraft, has been operated over the full performance spectrum as specified, and is in the final stages of development prior to qualifying for flight use next year.

The aircraft for this first manned space flight is being produced by North American Aviation.

Although no performance figures have been released, the engine is reported capable of producing more than a half-million horsepower during flights of the X-15, although it weighs little more than a 300-hp V-8 engine. By comparison, the entire power plant of the largest aircraft carrier, the *USS Forrestal*, produces about 250,000-hp when driving the ship at flank speed.

▶Inertial Flight-Data System for the X-15

An extremely precise inertial flight-data system for manned probes of space by the hypersonic X-15 rocket aircraft, scheduled for first powered flights in February, 1959, is being made ready by the Sperry Gyroscope Company at Great Neck, N. Y.

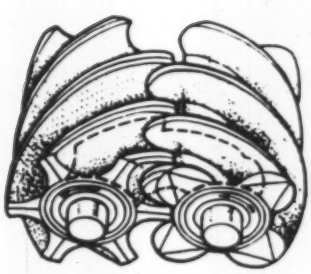
The unique equipment will direct the pilot from the instant of launch through the high-velocity acceleration phase of the X-15 mission and provide data enabling him to control the research craft during the critical period of re-entry into the earth's atmosphere.

A compact, three-gyro stable "platform" will provide critical attitude, velocity, distance, and altitude sensing. The platform, which incorporates outstanding advances in electronic miniaturization, contains all its own power supplies and amplifiers.

A lightweight computer digests and interprets these data and displays them pictorially for the pilot on specially developed cockpit instruments. In addition, the system's sensors and computer will feed data to specialized airborne and ground-based recorders for permanent charting of each flight.

The X-15 system is designed to accept exact velocity signals from a Doppler navigation system in the B-52 "mother plane" until the moment of launch and thereafter to function as a pure inertial system—completely without outside aid.

Each component, and the entire system, are able to withstand accelerations of more than 10 g and must function perfectly in the weightless environment the X-15 will encounter during portions of its 500-mile flights over the test range at Edwards Air Force Base, Calif., in the joint NASA-USAF-Navy project.



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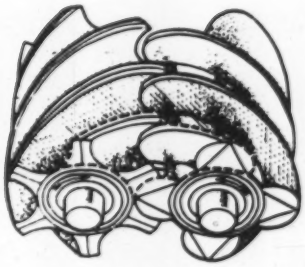

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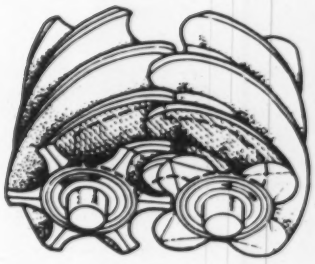


Pos. 4

Materials Briefs

▶Defense Metals Information Center

THE Defense Metals Information Center, operating under the direction of the Assistant Secretary of Defense (Research and Engineering), has been established at Battelle Memorial Institute.

With much broader responsibilities than its predecessor, the Titanium Metallurgical Laboratory, the Center collects and disseminates technical information on titanium, beryllium, refractory metals, high-strength alloys for high-temperature service, corrosion and oxidation-resistant coatings, and thermal-protection systems. Defense contractors, subcontractors, and other suppliers, as well as Government agencies, will be served by the Center.

▶Rubber Bonded to Metal

Optically smooth precision rubber parts ground to dimensional tolerances usually expected only from metal can be achieved with a new system of bonding Hycar American rubber, a B. F. Goodrich Chemical Company product, to metal parts.

Called Permadizing, the system was developed by Stillman Rubber Company of Culver City, Calif. Rubber-to-metal-bonded parts are free of flash, precise in dimension, and have optically flat surfaces for effective sealing at almost zero pressure.

The new bonding process can be used with almost any metal and provides what amounts to a new material, a rubber-metal composite whose dimensions can be held as closely as all-metal parts. Rubber surfaces as fine as five microfinish are produced.

▶Steel With 400,000-Psi Tensile Strength

Tensile strengths of more then 400,000 psi have been attained experimentally with an ultrahigh-strength steel perfected by the metallurgy department of the Ford Motor Company.

These have been achieved by plastically deforming metastable austenitic steels above the martensite temperature and then transforming them to martensite. Initial experimental studies were confined to steels having a modified 4340 composition, but others permitting a greater degree of hardening or strengthening currently are being evaluated.

Toughness of the new Ford steels is equivalent to the best ultrahigh-strength steels commercially available. Preliminary experiments indicate that they largely retain their excellent properties as low as liquid-nitrogen temperatures, −385 F.

The fatigue limit of high-strength steels usually is found to be about half the tensile strength. On that basis, the fatigue limit of the new Ford-developed steels should approach 200,000 psi representing a 30 per cent improvement over present alloys.

By comparison, the strongest metals known appear in the form of "whiskers," incredibly fine filamentary single-crystal wires with diameters a small fraction of a human hair. These whiskers, in the case of 1-micron-diam iron, have the maximum theoretical tensile strength predicted by metal physicists—approximately 1,000,000 psi.

▶ High-Tensile High-Yield Aluminum Alloy

A new alloy of high tensile and yield strengths with high elongations and excellent castability has been announced by Reynolds Metals Company.

Designated alloy 357, it handles with all the ease of alloy 356 but develops considerably higher mechanical properties. Any foundry which casts alloy 356 can handle the new 357 and obtain properties generally associated with alloys of higher price that are more difficult to cast.

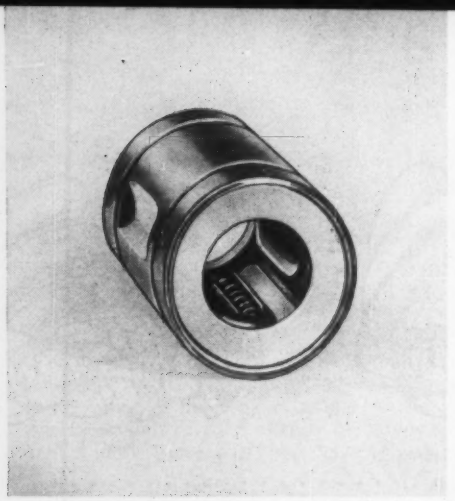
The following typical permanent-mold T-6 properties were listed for alloy 357: Tensile strength, 48,000 to 50,000 psi; yield strength, 35,000 to 37,000 psi; elongation, 6 to 10 per cent.

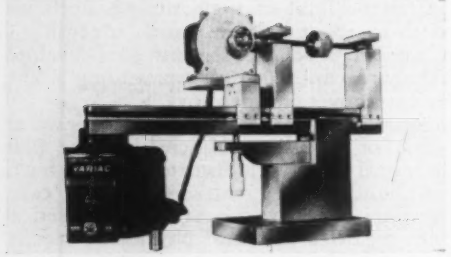
Adhesive Polymer

A NEW FAMILY of rubberlike adhesives that will bond nearly any surface to itself or to another has been developed at B. F. Goodrich's Research Center, Brecksville, Ohio. The molecular structure of the new group of adhesives is radically different from that of other rubberlike cements, being a sticky polymer with built-in adhesive characteristics, requiring no added resin or other tackifier.

The new polymer is now available as a laminating adhesive known as A-916-B, and should prove a solution to difficult laminating problems. The pressure-sensitive thermoplastic material bonds new synthetic films to all kinds of metals as well as to paper, wood, glass, plaster, and other materials—without heat or special surface treatment.

It is prepared in highly concentrated solution—50 per cent solids—has excellent storage stability, and adhesive and cohesive properties last indefinitely. It can be applied by brush or roller-coated, knife-coated, or modified for spray. The deposited films are permanently pressure-sensitive with adhesive strength greater than cohesive strength in most cases.





Rolling friction's lower coefficient is substituted for breakaway friction in extremely sensitive instrument bearings, kept in motion by "intraciprocation." Various combinations of speed and stroke can be established on the test rig to determine optimum conditions for a given mass.

Reducing Linear Bearing Friction

INTRACIPROCATION, a new method of reducing linear bearing friction, has been discovered by Thompson Industries, Inc., Manhasset, N. Y., in developing a new type of instrument bearing for use in inertial-guidance-system components. Because of the importance or extreme sensitivity in accelerometers, G switches, and other inertial devices, friction must be kept to a minimum. Since the load is alternately applied and removed, the introduction of a constantly reciprocating small shaft to be kept in motion by electromagnetic coils or a small servo-type motor keeps the bearings in constant motion, thus eliminating breakaway friction.

In any linear motion, whether it be intermittent or continuous, the bearing elements must periodically come to a dead stop, which changes the friction coefficient of the mating parts from a rolling coefficient of friction to a static coefficient of friction. The static-friction coefficient is much greater than the rolling-friction coefficient and this difference is sometimes referred to as "breakaway friction." With the intraciprocation principle the superimposed reciprocation keeps the balls activated at all times so that they are never subject to the relatively high friction of the static condition.

Any contamination of linear bearings in extremely sensitive devices can limit their performance by causing hysteresis or poor repeatability of the mechanism. With intraciprocation a minute dirt particle which might cause unpredictable sticking will be pushed aside or its effect negated by the power applied to produce the reciprocation. This is also true of any adverse effect which might result from ball irregularities due to damage or imperfect manufacture. Since accurate sensing of acceleration in various directions is the basis of inertial navigation, extreme accuracy of the feedback data from the accelerometers is vital.

By applying the new principle of intraciprocation, sensitivities comparable to shaft angles of less than one minute, 0.00029 g, are possible. This phenomenally low friction is approximately a 20-fold improvement over conventional arrangements.

The principle consists of a linear bearing and a shaft. Either the shaft or the bearing is reciprocated at a relatively high frequency through a short stroke while the other member is free to traverse in a linear motion. A magnitude and frequency of reciprocation of one of the members is selected which is appropriate to the mass of the other member which has sufficient inertia to be unaffected by the "mechanical ball activation."

Another important feature of this principle is that it very simply enables the position or motion of the supported member to be biased or changed without direct application of force to it. By remote or direct external control, the speed of the reciprocation stroke in one direction can be made to exceed the speed in the other direction. This creates a controlled unbalance which can be used effectively to govern the action of the mass for inertial guidance or other purposes.

Verbal Instructions for Computer

TECHNICIANS of the U. S. Air Force Air Materiel Command and of Remington-Rand Division, Sperry-Rand Corporation, have jointly developed a method for using a limited vocabulary of English verbs to instruct business-type computers.

The basis for the new system has already been machine tested, is now in successful limited use, and will be in general operation at major AMC activities by the end of 1958.

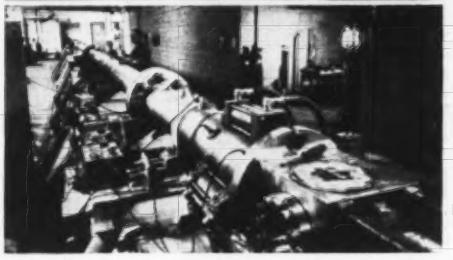
The new method, known as the Air Materiel Command Automatic Compiler, or AIMACO, will initially use only 30 English verbs, but has flexibility of enlargement to additional verbs as circumstances dictate.

In a precise sense, instruction coding is not eliminated by the new English-language program; rather, it too has been automated. To replace the laborious task of manual translation from English to machine language (a bottleneck since the advent of electronic-data processing) the new system simply uses a large-scale computer to make this conversion electronically, for itself and for other makes and models as well.

AIMACO employs the basic concepts of Flowmatic, an automatic programming technique developed by Remington-Rand for use only with its own UNIVAC computer system. In the AMC method, Flowmatic is modified and expanded to provide a means for programming single and multiple address, and fixed and variable word-length, computers.

As an actual example of this intercomputer coding capability, programming for the giant new UNIVAC 1105 computer scheduled for early delivery to AMC is now being done on one of the original large-scale computers, the UNIVAC 1.

A basic future objective is to progress from the 30 verbs to a much more general use of the English language, thus to still further simplify and accelerate programming and render more efficient the human-machine relationship.



Dissociated ultrahot air is discharged as a plasma stream from General Electric's large, new plasma-jet generator, *upper photo.* The highly instrumented tube portion of GE's space-technology tunnel, *lower photo,* expands gases through a nozzle onto test specimens for aerothermodynamic studies.

G-E Space-Technology Studies

NEW space-technology tools in the Aerosciences Laboratory located at the General Electric Company's Missile and Ordnance Systems Department, in Philadelphia, Pa., are being used to help produce vehicles for flight into outer space, and to help solve the nose-cone re-entry problem on the Air Force's ATLAS and THOR ballistic-missile programs.

Included is America's biggest plasma-jet generator for testing space models under the high-temperature and chemical conditions of atmospheric re-entry from outer space: A unique, 120-ft-long shock tunnel, largest in the country, used to study space-vehicle design requirements at velocities up to 25 times greater than the speed of sound; a solar furnace for making non-contaminating tests; and electronic mass accelerators for free-flight tests.

Newest of the space-technology tools is the giant plasma generator, installed at G-E's Switchgear Department, one of the few facilities in the free world capable of generating the electric current needed. The plasma jet yields temperatures more than twice the surface temperature of the sun.

The large, air-stabilized electric arc, enclosed by a chamber 18 in. through and 3 ft high, as contrasted to forerunners of 4 × 10 in., is a 3-phase a-c model that has been run at the rate of 15,000 kw.

Advantages of an arc of this size are that more nearly full-scale models of re-entry vehicles can be tested in its plasma flow and that the simulated Mach 12-25 speed of the plasma jet more nearly approximates actual space-flight conditions.

G-E is a pioneer in stabilized-arc development and has designed and built both liquid and gas-stabilized arcs. The 6-in. × 120-ft shock tunnel permits high-temperature and high-speed studies—aerothermodynamics. Unlike other conventional shock tubes, this space-technology tunnel is equipped with an expansion nozzle and a large reservoir, which contains the specimen. Studied by means of schlieren photography, specimens are subjected to Mach 15-25 blasts of air that are compressed and driven down the tube by exploding gases. The 18,000 F and 5000-psi air then flows through the expansion nozzle in front of the reservoir over the specimen. Flow patterns set up by these fast-moving gases yield data that will largely determine space-craft design.

Three smaller, companion tubes of varying lengths, diameters, and inside configurations are used for supporting tests and provide basic information on high-temperature, gaseous physics.

An example of other research tools is the arc-discharge hypersonic gun, operated by striking arcs between evenly spaced electrodes along a tube to heat a gas—helium, for example—whose expansion will force a projectile at increasing speeds down the tube. The uniformly increasing pressure behind the mass should propel it, by the time it reaches the end of the tube, at a muzzle velocity vastly greater than that produced by a 16-in. cannon.

Chemical means of propulsion, for example, yield less than 25,000 fps, while electrical means theoretically may push a mass to 60,000 fps. The purpose for such high velocities is to provide free-flight tests after the mass leaves the tube at speeds equivalent to those in space. The mass so propelled, possibly a model space vehicle, can subsequently be studied, by spectroscopic or telemetric means, to provide information on actual space conditions.

Pipeline Transportation of Texas Lignite

PIPELINE TRANSPORTATION of Texas lignite for distances less than 100 miles would cost more than moving it by truck or rail because of degradation of lignite in the line and the high cost of dewatering it for use. This is the conclusion of the Bureau of Mines, Department of the Interior, from a study conducted co-operatively with the Texas Power and Light Company. Hydraulic transportation of lignite for longer distances or transporting of bituminous and higher ranks of coal by pipeline were not included.

The study was limited by considering principally one material, Sandow lignite, restricting the medium to water, confining the distance of transportation to 20 to 100 miles, and limiting capacities from 2000 to 5000 tons per 24-hr day. However, when compared with current competitive transportation costs, the report states, the cost of hydraulically transporting and drying lignite was considered to be too high to justify further investigation. The Bureau adds that conclusions reached regarding lignite do not necessarily apply to the hydraulic transport of bituminous and higher-rank coals.

A copy of the report, which should be identified by number and title, R. I. 54-4, "A Study of the Feasibility of Hydraulic Transport of a Texas Lignite," can be obtained from the Publications-Distribution Section, Bureau of Mines, 4800 Forbes Street, Pittsburgh 13, Pa.

New Power Reactor Concepts

Two new nuclear power reactor design concepts were disclosed by William E. Shoupp, Mem. ASME, technical director of Westinghouse Electric Corporation's atomic power department, during a recent press visit to the Westinghouse Research Laboratories (see Photo Briefs) and the Atomic Power Department.

One new reactor design involves the use of thermoelectric materials in the reactor fuel elements to convert the nuclear-derived heat directly into electricity. Another new design makes use of an organic-moderated fluid-bed reactor in which conventional control rods are not necessary and the fuel is in the form of pellets no larger than marbles, floating in oil.

In describing the use of thermoelectric materials for building reactor fuel elements, Dr. Shoupp pointed out that thermoelectric substances can convert the heat of a burning fuel, or other high-temperature source of heat, directly into electricity. Such materials produce electricity simply, silently, and without moving parts of any kind. Westinghouse Research Laboratories have recently discovered a new "essentially unexplored" class of these materials which can operate the 2000 to 3000 F range.

"The potential applications of thermoelectric materials are many," Dr. Shoupp said, "and one of the most attractive is in nuclear reactors where we find exactly the desired conditions: Concentrated heat source, high temperatures, and electric power as the end product.

"Simplicity of design and construction, and efficiency of operation are the two main important advantages of direct-conversion reactors. Direct production of electric power within the fuel elements eliminates the necessity of a steam cycle and thereby can reduce space requirements considerably."

The space-reduction factor is especially important in the application of reactors for propulsion or special military requirements.

Conventional control rods have been eliminated in an organic-moderated fluid-bed reactor. Increasing the flow of fluid through the reactor lifts the pelletized fuel and starts a chain reaction.

Final design configurations have not been determined, but it is expected the element will be a flat plate with electrical connections at each end. The nuclear fuel will serve as the heat source and will be completely clad with a material such as stainless steel to prevent spread of radioactive products. The thermoelectric material will surround the nuclear fuel.

The Organic Moderated Fluid Bed Reactor, OMFBR, is being developed by Westinghouse for the City of Burlington, Vt. Instead of using movable control rods and fuel elements in a fixed position, this plant will use small marble-sized fuel pellets. Conventional-type control rods will not be necessary. The fuel pellets will lie in a large cylindrical container, open at the top, and with fluid-flow holes in the bottom. Surrounding this container will be the reactor vessel.

The reactor works like this: Before start-up, the fuel pellets rest in a settled, packed bed. By proper choice of fuel enrichment and pellet size, no chain reaction would occur in this condition because of the close spacing of the pellets. To start the reaction, the flow of oil would be increased, thus lifting the pellets and dispersing them uniformly through the fluid. By controlling the oil flow, the chain reaction may be increased or decreased.

Pneumatic Dunnage

PNEUMATIC DUNNAGE developed by the Army Quartermaster Corps to prevent damage to military supplies during shipment will be given intensive testing by Naval Ordnance Materials Handling Laboratory, U. S. Naval Ammunition Depot, Earle, Red Bank, N. J.

The pneumatic dunnage consists of specially designed, tough, elastic air pillows which are inserted in open spaces between the cargo and walls of a vessel or freight car. The dunnage is intended to replace conventional lumber shoring with considerable savings of material and labor.

A 28-lb unit consists of an outer casing of nylon fabric coated on the outside with neoprene, and an inner bladder of unsupported butyl compound equipped with a large-volume diaphragm valve. The dunnage can be reused indefinitely. When deflated, each bag occupies no more space than a large telephone directory.

Cross-Country Belt Conveyer

A CONTRACT for the longest permanent cross-country-transport belt-conveying system ever constructed, $5^1/_2$ miles in length, has been awarded by Ideal Cement Company of Denver, Colo., to Link-Belt Company.

This unique "rubber railroad," using 36-in-wide belts, will transport crushed limestone and shale, the raw materials for cement, at a rate of 1000 tons per hr, from Ideal's Lawrence, Okla., quarry to its Ada, Okla., cement mill. Construction of the all-weather conveyer has begun and completion is scheduled for early 1959.

The entire multimillion-dollar system comprises seven conveyers arranged consecutively to provide continuous flow of material. The length of the longest individual conveyer will be 11,920 ft, the longest in the world today, according to Link-Belt. This conveyer will require a single rubber belt more than $4^1/_2$ miles long.

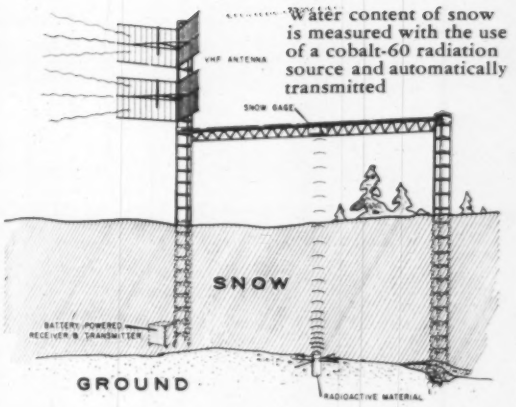
Nuclear Briefs

▶Radiation Detector Gages Water

A RADIATION detector of the scintillation type will be used automatically to determine the water content of snow in California's Sierra Nevada and Idaho's Bitterroot Mountains. The information, now obtained by sending survey parties on skis and snowshoes, is used by the U. S. Army Corp of Engineers to predict runoff, an important factor in planning and operating irrigation, flood-control, and hydroelectric projects.

Sierra Electronic Corporation of Menlo Park, Calif., a Philco subsidiary, designed and developed the telemetric system. A small deposit of cobalt-60, buried at ground level, beams radiation to a detector 15 ft above. This consists of a $1^1/_2$-in. thallium-activated sodium-iodide scintillation crystal associated with a photomultiplier tube. Since radiation absorption is affected by the water content, rather than the depth of the snow, gaging is simply achieved. Battery-power VHF radio transmitters are interrogated by radio tones of selected frequency as required, or the system can be operated manually or automatically.

Reports on temperature, barometric pressure, humidity, wind velocity, or other weather phenomena useful in forecasting electric-utility demand can easily be added.



Water content of snow is measured with the use of a cobalt-60 radiation source and automatically transmitted

▶Shippingport Controls Operating Effectively

The electrical auxiliary and control systems of the Shippingport, Pa., nuclear power plant have demonstrated their ability to control the station safely and effectively.

This was reported by H. G. Frus, H. A. Thompson, H. A. Van Wassen, and E. J. Woolever of the Duquesne Light Company, Pittsburgh, Pa., in a paper prepared for presentation at the Fall General Meeting of the AIEE.

The auxiliary power requirements of Shippingport reactor, it was stated, are much greater than for comparable-size units in plants burning conventional fossil fuels, but the operating experience to date indicates that the plant is simpler to operate than an equivalent coal-fired plant.

The principal reason is that a minimum of operator actions is required. The plant as a whole is extremely stable and highly responsive to load changes.

▶New Hanford Reactor

The Atomic Energy Commission has assigned final engineering design of a large-scale reactor and certain supporting facilities to be built at Hanford Works, Richland, Wash., to the General Electric Company, operator of the AEC's Hanford Works. The estimated cost is $145 million, of which $45 million has been authorized for this fiscal year for initial work. Design engineering and construction will continue over a 4-yr period.

The recently authorized reactor is for the production of special nuclear materials, with design features capable of conversion, if later desired, to permit power take-off.

Negotiations are now being conducted with Burns and Roe, New York City, by the Commission's Hanford Operations Office, for architect engineering services on portions not assigned to GE.

▶Pilot Waste-Calcining Facility

Construction has been started by the Fluor Corporation, Los Angeles, Calif., on a $6-million pilot plant to be completed by January, 1960, at the AEC's National Reactor Testing Station, Idaho, for calcining high-level radioactive liquid-waste products.

The waste-calcination facility is designed to reduce these wastes to about one seventh of their present bulk with a 1-gpm-of-waste capability, and "fixes" highly radioactive fission products, which normally must decay for as much as 800 yr before they can safely be discharged to water and air, in a less mobile form.

Developed by Phillips Petroleum Company and Argonne National Laboratory, the fluidized-bed calcination process is a mechanically simple means of rendering less bulky, and significantly less corrosive, the fission-product solutions resulting from fuel-element processing for recovery of unburned uranium at a cost economically competitive with liquid storage and with less hazard potential. Radioisotope-recovery values will not be destroyed.

The process involves evaporating the water, decomposing the nitric acid to oxides of nitrogen, and converting aluminum nitrate to aluminum oxide. It yields a granular solid-alumina product containing all fission products removed from the fuels except those in the dust entrained in the calciner fluidizing air. These products are removed by scrubbing and filtration techniques. A portion of the ruthenium volatilizes in the calciner and is separated by adsorption.

▶EBWR to Be Converted to 100,000 Kw

The architect-engineering firm of Sargent and Lundy, Chicago, Ill., has been awarded a contract to plan the conversion of the Experimental Boiling Water Reactor, EBWR, at the Argonne National Laboratory to a 100,000-kw plant from the design level of 20,000 kw at a cost of $1.5 million.

The 80,000 kw of new heat generated by EBWR would be piped as desired into the Laboratory's system, for heating buildings. Electric generation would remain at the present 5000-kw level.

Argonne scientists and engineers are designing a new and larger core, to convert EBWR to 100,000 kw. This core is to contain a greater number of enriched fuel elements in a 5 × 5-ft area, instead of the present 4 × 4 area.

Alcoa's 375,000-kw Warrick, Ind., power station will use 5.23 lb of aluminum per kilowatt of installed capacity—a new record

Aluminum Power Plant

A 375,000-kw steam electric-generating plant being built adjacent to the site of the aluminum smelter at the Aluminum Company of America's new Warrick, Ind., works will use a total of approximately 2,000,000 lb of aluminum or 5.23 lb per kw of installed capacity—a new record. The station will supply the power to produce 15,000 tons of primary aluminum annually at the new smelter.

The power plant will have three units. The first is completed and the rest will be essentially completed by mid-1959. Each will employ a 1,000,000-lb per hr steam generator, supplying steam to a 125,000-kw General Electric turbine-generator and for process-steam requirements.

Ebasco Services, Inc., consultants for Alcoa's Warrick power development, are serving as designer, purchasing representative, and construction supervisor for the entire project.

The coal-handling operation at the station will involve a network of aluminum-covered conveyers.

Electrical equipment comprises a virtually all-aluminum installation. Conductor, switchyard structure, switchgear, conduit, panels, cable trays, and lighting fixtures are major applications. Use of aluminum in every case represents long-range economies. For many uses, aluminum constitutes the least expensive material as bought. In the case of structures, net savings with aluminum result after lower erection costs are reflected in over-all installed costs.

Almost 40 per cent of the aluminum used in the station is employed in the boilers, turbines, condensers, and feedwater heaters and their auxiliary and structural components.

Among these applications is the boiler "lagging," the outer skin protecting the thermal insulation covering the steel inner casing of the boilers. Aluminum lagging is an Alcoa-pioneered use of aluminum, developed as a result of Alcoa's experience with an all-aluminum welded casing on a boiler at its Sandow plant, installed in 1953.

Spectacular among the mechanical applications of aluminum at Warrick is the use of heat-exchanger tubing in the Foster Wheeler condensers. In the three condensers, 165 miles of 1-in. Alcoa Alclad (inside) 3003-H14 tubes are used. The aluminum was chosen over Admiralty tubes, at an estimated saving of $160,000. Substantial quantities of aluminum tubes are used in the No. 1 and No. 2 Foster Wheeler horizontal U-tube-type low-pressure feedwater heaters of all three of the units.

Considerable aluminum is used for components of the turbine generators: Lube-oil coolers, gland exhausters, and hydrogen coolers fabricated by the Ross Heat Exchanger division of American Radiator & Standard Sanitary Corporation. As far as is known, each of these applications represents the initial use of aluminum for that purpose.

Turbine maintenance will be performed with the aid of an all-aluminum canopy. A quonset-type structure, the canopy consists of six sections that may be moved independently on rails running the length of the turbine deck.

Single largest use of aluminum in the plant is grating. Some 84,000 sq ft of grating are installed in the steam-generator auxiliary areas and in the station proper. Similar uses are 16,500 linear ft of handrails, and 2600 stair treads. These last are specially designed die-cast treads, with an abrasive nose, a product recently made commercially available by Alcoa.

Substantial use of aluminum is made at Warrick in such diverse additional all-aluminum applications as condensate and oil tanks, control panels and control tubing, reflective insulation and insulation lagging, conveyer and trench covers, capillary air washer, stack ladders, and stack-lighting platforms.

Architectural aluminum is specified for use throughout the plant, and the plant is even surrounded by an aluminum cyclone fence.

Gas-Suspension Reactor Coolant

RECENT RESEARCH at Babcock & Wilcox has shown that the heat-transfer and heat-transport properties of gases are greatly improved by suspending fine particles in the gases. The result is a low-pressure, low-cost reactor coolant which avoids many of the major design problems encountered with liquid coolants. According to preliminary studies, the coolant can be combined with a high-temperature steam cycle.

A gas-suspension reactor coolant will consist of fine particles (less than 5 microns) of graphite or solids suspended in carbon dioxide, nitrogen, helium, or argon. The density of these mixtures will vary between 5 and 15 lb per cu ft at an operating pressure of 100 psig or less. The coolant will be circulated in a closed primary system in an arrangement similar to primary systems for pressurized-water, gas, or liquid-metal coolants.

Babcock & Wilcox's work has been largely with graphite-CO_2 mixtures with densities up to 8 lb per sq ft, circulated in a $^3/_4$-in. iron-pipe-size closed loop at 35 psig, 300 F, and 40 fps. Loop operation has been very satisfactory with no evidence of erosion or significant particle adherence to surfaces. Heat-transfer rate increased by a factor of eight over that for CO_2 at the same pressure, temperature, and velocity. In addition, the heat transported around the loop increased by a factor of 21, indicating the greatly reduced size of boiler and superheater that would be required, as well as a marked reduction in total cooling surface.

The improved heat capacity of the coolant will also permit an increase in the reactor-inlet temperature to 487 F (as compared to the 275 F inlet for Calder Hall) and eliminate the need for economizers and the two-pressure boiler system. Moreover, the possibility of extracting a higher temperature steam will result in a higher feedwater temperature and a significant improvement in steam-cycle efficiency. Reductions in pipe sizes, valve, and fitting costs also follow.

Fuel, operating, and maintenance costs give every promise of being low since the coolant characteristics are favorable. Low pressure, good materials compatibility, and low neutron-capture cross section combine to insure excellent neutron economy and trouble-free operation.

It is estimated that a 2-yr program will be required to complete the development of gas-suspension reactor coolants.

Other attractive possibilities for this coolant include the replacement of Dowtherm in chemical-process, reheat, and other heat-transfer applications.

Air-Cooled Sinter

A CIRCULAR air cooler, the first of its kind in this country, which cools hot sinter from 1300 to 200 F in less than 30 min, has been installed at the Cleveland Works of Jones & Laughlin Steel Corporation.

Built by Dravo Corporation of Pittsburgh, Pa., under a licensing agreement with the Lurgi Company of Frankfort, Germany, the cooler utilizes 450,000 cfm of air (almost 16 tons) to bring about this sharp temperature reduction.

At this heat level the sinter (the agglomerated or fused-iron-ore fines too small for blast-furnace charging) can be transported by rubber conveyer belt to blast furnaces or to storage areas without damage to the belt.

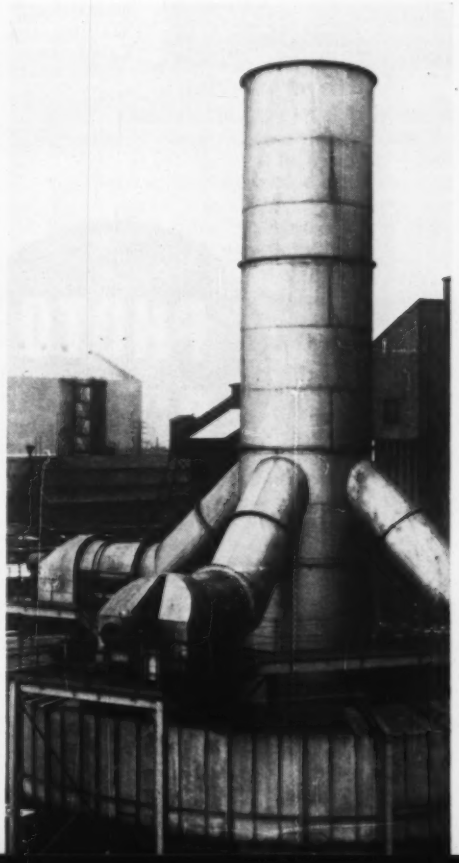
The air flow, induced by three 150,000-cfm fans, moves up through the hot sinter as it travels around the 205-ft circumference of the cooler on 7 × $5^1/_2$-ft trays. The air is exhausted to a 16-ft-diam central stack 100 ft in height.

As the fused material leaves the sintering machine, it is broken into lumps which fall on an oscillating screen for removal of small particles and dust. It then moves to a Dravo-Schenck vibro-feeder which "flows" the material to the cooler pallets.

Installation of the Dravo air cooler eliminates the use of water for cooling, a process still used in many plants today. It also eliminates the need for a large storage space for spreading the material for cooling. Use of water, too, causes the sinter to become very brittle and break up during quenching.

Measuring 65 ft in diam, the cooler is a part of a new sintering plant installed at a cost of $7 million, and is the first of seven such pieces of equipment now being fabricated and erected in this country by the Pittsburgh concern.

One of similar size is being installed at the Ashland, Ky., works of Armco Steel where Dravo is building a complete sinter plant to Lurgi design. Six others of even larger size are being installed at Dravo-built sinter plants for U. S. Steel. Three are being built at Gary, Ind., and three are being erected at Saxonburg, Pa. Upon completion the U. S. Steel's installations will be the country's largest, each with an output capacity of 15,000 tons of sinter per day. An eighth cooler of straight-line design is also being built by Dravo for the McLouth Steel Company of Detroit, Mich.



Sinter is cooled from 1300 F to 200 F in less than 30 min in a new type of circular air cooler

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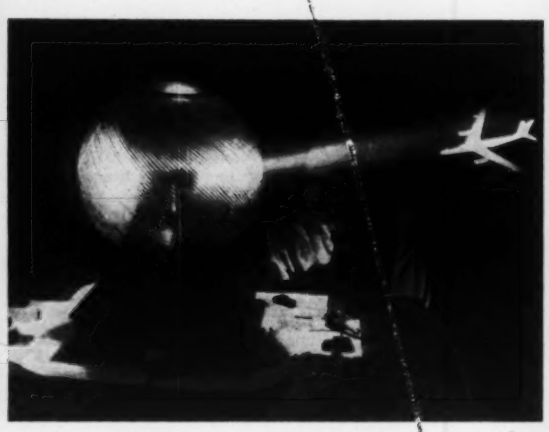

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laboratory building

Dedicated on Sept. 20, 1958, the new Westinghouse Research Laboratories building is near Pittsburgh, Pa. Nucleus of Westinghouse research, it houses the laboratories, offices, shops, and other requirements for more than 800 scientists and technicians. Included in these facilities are a technical library containing 30,000 volumes and subscribing to more than 500 periodicals; a complete metals-processing laboratory; an instruments laboratory; several machine shops; a glass-blowing laboratory; a photographic and reproduction department; drafting facilities; and other services. The various activities under way at these facilities are organized into eleven departments: Chemistry, Electromechanics, Electronics and Nuclear Physics, Insulation, Mathematics, Mechanics, Metallurgy, Physics, Physics Projects Laboratory, Solid State Physics, and Technology.

PHOTO BRIEFS

7

. . looks at new developments at westinghouse

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1 Motor for 950-F Operation. Inorganic insulation, special bearings, and pure-silver wire permit an experimental motor, here being "broiled" in the searing heat of jets of burning gas, to operate continuously more than 100 hr at 950 F.

2 & 3 Helisphere Radar Antenna. High-frequency radar waves are reflected by the helical-patterned metallic thread on one side of the balloon antenna and emerge unaffected on the other side, because the helical pattern causes strips on the opposite surface to lie at right angles to the reflected radar waves. The antennas are inflated inside by a rubber sounding balloon. Only the small central feed horn rotates, requiring less power than ordinary antennas which rotate entirely.

4 & 5 Atom Shaker. The atoms of a crystal vibrate up to 20,000,000 times a second in the small metal "box" between the poles of a large electromagnet. A phenomenon known as nuclear magnetic resonance absorption, demonstrated with an array of small compasses, is used to study the interaction between atomic nuclei and their surrounding crystals. The experiments proved that the interaction was electric rather than magnetic. The technique has been used to study the structure of semiconductors, and should be useful with metals.

6 Electricity Directly From Heat. Ten watts of electric power are generated directly from heat with an experimental thermoelectric generator. The principle combined with a hot-cold-light panel, no thicker than a picture frame, may some day cool your home in summer, heat it in winter, and light it all year round.

7 & 8 Ultrasonic Sink. A newly developed magnetostrictive transducer converts electrical pulses into ultrasonic vibrations, and is twice as efficient, one fourth as costly, and less bulky than existing transducers. Applied to a kitchen sink it produces cavitation, creating and collapsing millions of tiny vapor bubbles with instantaneous pressures as high as 75,000 psi to greatly simplify the cleaning of dishes and utensils.

8

research laboratories

Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

The End of Windscale

IT WILL be recalled that, a year ago, there was a serious burnout at the Windscale atomic energy plant of the United Kingdom Atomic Energy Authority, which resulted in the No. 1 pile of the two in this station, which was constructed to provide a source of supply of plutonium for military purposes, being put completely out of action. Pending the report of the committee appointed to investigate the cause, No. 2 pile was shut down. After it had been established that the initial cause of the accident was the release of what is known as "Wigner energy" from graphite which had been subjected to irradiation, the announcement was made that No. 2 pile would be restarted after the installation of an improved system of instrumentation to measure the temperatures in the graphite and the fuel. The Atomic Energy Authority has now decided that the cost of the modifications (equivalent to about $\$1^1/_2$ million) would increase unduly the cost of the plutonium produced during the remaining life of the pile; so, as the Calder Hall reactors are now producing substantial quantities of this element and others will be coming into operation shortly, the Windscale plant is to be abandoned. The uranium fuel will be discharged and reprocessed for other uses, and the equipment removed as far as can be done. Some of the buildings will be used for experimental purposes, which will save a certain amount of new expenditure, and the chemical processing plant will be kept in operation; but, as a reactor station, Windscale is finished.

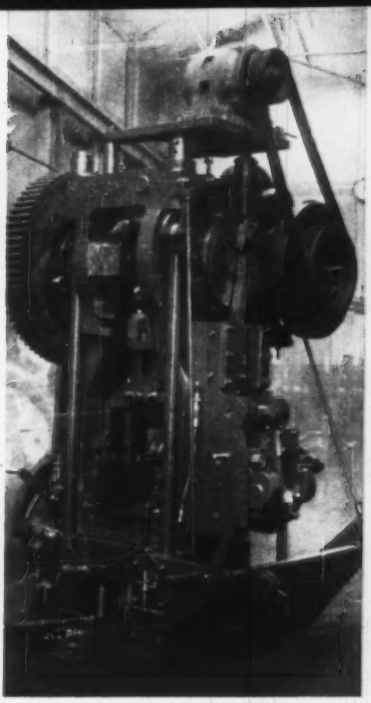
Plastic-and-Glass Hose Ramp

THE British Plastics Federation, whose headquarters are at 47-48, Piccadilly, London, W.1, England, have recently formed a new group to deal with reinforced plastics, thus coming into line with the United States and France, where the rising importance of this structural material has already been similarly recognized. In October the Federation held a Reinforced Plastics Technical Conference at Brighton, England, which was the largest yet convened in Europe on this subject. Many new developments and applications were recorded, one of them being the hose "bridge" made of plastic reinforced with glass fiber. The weight of a complete set is only 235 lb, but it will support the weight of a 10-ton truck. It was designed in collaboration with the British Ministry of Works, and is made by Microcell Ltd., 56, Kingsway, London, W.C.2, England.

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

Toggle Press for Hot Brass Forging

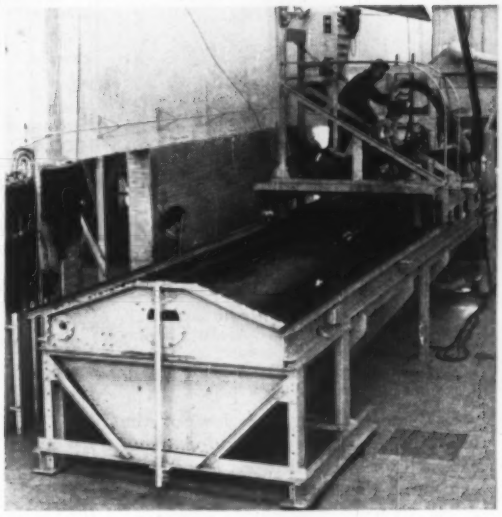
FORGING in split dies by toggle-action press is a branch or manufacture for which Taylor & Challen, Ltd., Derwent Works, Birmingham 19, England, have been making standard presses for a number of years. The process is now being applied to harder materials than brass, such as titanium, duralumin, and stainless steel, and for this purpose they have produced a new design of press, No. 1878, illustrated herewith. In this press there is the usual toggle device for holding the split dies, and three punch actions arranged to enter the dies from both sides and from below, as well as a main punch mounted on the main slide of the press. The punch action on one side (the right, as the operator sees it) is separately driven by an outside crank on the main shaft, to give independent pressure as well as faster movement; it can apply pressures up to 20 tons, and can be timed to operate at any point within the whole cycle of the main action. It gives a dwell at the end of the working stroke of 90 deg, with very fast approach and withdrawal motions, and can impart a stabbing blow near the end of the main action so as to extrude backward a solid portion of the billet extruded by the main action into a side cavity in the die. In the example shown, a pillar-type faucet, the side action extrudes one branch of the forging from a correctly proportioned lump of metal which is presented to it as a solid piece. The press is controlled through a friction clutch of the lubricated metal-plate type, working in conjunction with a circumferential toggle brake. Very delicate inching control can be obtained by this means, even of the accelerated side motion, without interfering with the normal drive. In production, the press motions are actuated by air valves. The operating speed is 40 strokes per minute.



Glass-fiber-reinforced plastic hose ramp will support the weight of a ten-ton truck, *above*

Research on dredging uses test stand of type pictured for experiments with cutters, *right*

Five-action toggle press for hot brass forging, *far right*



Research on Dredging

PROBABLY no country in the world has had more occasion to study the techniques of dredging than has the Netherlands, but until comparatively recent years the know-how was chiefly concentrated in the accumulated records of the private shipbuilding firms specializing in the construction of this type of craft. It is there still, of course, but since the war, under the stimulus of the national drive to set the country on its feet again after the German occupation of the war years, the six principal firms so engaged have combined to establish a highly specialized research station in which to pool and extend their knowledge and so to improve the efficiency of their designs. To do this the six firms—Conrad-Stork, of Haarlem, Werf Gusto of Schiedam, De Klop of Sliedrecht, J. & K. Smit and L. Smit & Zoon, both of Kinderdijk, and Verschure & Co. of Amsterdam—formed themselves into an association entitled I. H. C. Holland. The group established at Delft the laboratories now known as the Mineral Technological Institute. As the title suggests, the scope of the researches undertaken is not restricted to the dredging of navigable waterways but extends also to dredging for tin and other minerals.

Down one side of the main building is a deep channel, constructed in reinforced concrete, which can be filled with water for model testing and provided with a bed of mud, sand, or any other desired material to be dredged. The channel is spanned by a traveling carriage on which can be mounted suction drag heads of various types and the pumps to operate them, with suitable recording equipment to measure the power required to propel or drag them, the flow through the suction pipes, the proportion of solid matter raised, and the like.

A smaller channel or tank, filled with bed material of known consistency, is used to test the effect of various forms of cutters; and a separate rig is provided for tests on pumps and pump impellers. This apparatus has been used recently for a series of comparative tests on the wear of the different materials employed in the manufacture of impellers, the method adopted being to use a five-bladed impeller in which one blade consists of material of known performance while the other four can be of four different alloys. The pump is then run under known conditions of speed and spoil-water mixture. The blades are all of identical form and size, so that a direct comparison is obtained.

Similar tests enable comparisons to be made between blades of different shapes working in material of constant characteristics, and with established shapes of blade and quality of material at different speeds. The purpose of these tests is not only to reduce the rate of wear to the minimum, but to insure as far as possible that it shall proceed at the same rate in all the parts subject to abrasion, so that, when renewal is necessary, the simplest course, that of renewing the whole unit, shall also be the most economical.

Substance in Brief of Papers Presented at ASME Meetings

M. ZANFARDINO
Staff Editor

ASME TECHNICAL DIGEST

Lubrication

An Investigation of Dry Adhesive Wear.....58—Lub-8

By R. P. Steijn, E. I. du Pont de Nemours & Company, Wilmington, Del. 1958 ASLE-ASME Lubrication Conference paper (in type; to be published in Trans. ASME—*J. Basic Engng.*; available to Aug. 1, 1959).

For a long time, the complex nature of the wear process has successfully thwarted serious efforts to obtain a fundamental understanding of what is actually taking place when two surfaces are brought in sliding contact. However, it appears that in the past decade substantial progress has been made, and, very recently indeed, systematic studies by various research groups have notably enlarged our comprehension of some of the physical and mechanical processes that take place when metals rub together. To an even greater extent, the many studies of wear in unlubricated metals have brought us closer to a working theory for predicting the behavior of metals in sliding contact. In this field, the contribution of Hirst and his coworkers in Andermaston, England, has been particularly outstanding.

It is the purpose of this paper further to elaborate on the wear of unlubricated metals by describing some experiments in wear research and some observations of interest to the student of wear, metal transfer, and the sliding surface.

Sliding-motion experiments under unlubricated conditions have been carried out on various metals, and the results are discussed in terms of the simple wear theory advanced by Archard.

Oxide-film formation has been studied by electrical contact-resistance measurements made in conjunction with wear tests. The effects on the wear rate and basic wear formula are discussed. For the ring apparatus, a modified expression for the wear formula is suggested to incorporate surface oxidation.

Although it was found that the sliding of a soft material on a hard material follows simple wear rules, discrepancies are reported for the wear of brass against brass. In these experiments, the wear rate is affected by the geometry of the apparent area of contact.

Axial, Relative Motion of a Circular Step Bearing.....58—Lub-1

By L. Licht, The Franklin Institute, Philadelphia, Pa. 1958 ASLE-ASME Lubrication Conference paper (in type; to be published in Trans. ASME—*J. Basic Engng.*; available to Aug. 1, 1959).

Equations relating the flow of the lubricant and the axial motion of an externally pressurized thrust bearing are developed. The bearing is shown to be stable when the fluid is incompressible.

Expressions for local stiffness and damping coefficients, useful in the evaluation of the dynamic response of the bearing, are given.

An analog-computer solution of the equation of motion is compared with the results of the corresponding, small displacement equation.

The analysis is made for a unidirectional thrust plate having a central recess. It can be extended to thrust bearings capable of supporting loads in both directions and having different pocket arrangements.

It is assumed that the bearing is restrained to permit only axial, relative motion and that a truly incompressible fluid of constant viscosity is supplied from a constant pressure reservoir. External drag effects are not considered in the equation of motion.

A simplified version of the Navier-Stokes equation (as applicable to laminar, viscous flow) in conjunction with the continuity equation, describes the flow in the annular and recess regions. After pressure terms are eliminated, a nonlinear differential equation in terms of displacement and its time derivatives results. This, in turn, is linearized, giving a second-order differential equation in terms of perturbation displacements.

Friction and Wear of Metals to 1000 C.....58—Lub-6

By E. P. Kingsbury and E. Rabinowicz, Massachusetts Institute of Technology, Cambridge, Mass. 1958 ASLE-ASME Lubrication Conference paper (in type; to be published in Trans. ASME—*J. Basic Engng.*; available to Aug. 1, 1959).

The evaluation of the frictional properties of materials at elevated temperatures, once a field of study of only mild academic interest, has recently become a subject of technological importance. High performance machinery like gas turbines contains bearings sliding at high environmental temperatures, and a severe design limitation is imposed by the need to keep the temperature of these bearings below the maximum effective temperature of available lubricants. In other applications high temperatures are produced by high sliding speeds, and again there are difficulties in providing suitable sliding conditions. Furthermore, it appears that each system yet evaluated is a special case.

Hence in order to investigate frictional phenomena, an apparatus was constructed to measure friction and wear at temperatures to 1000 C.

Sliding experiments using mainly the metals zinc, copper, titanium, and 1020 steel were carried out on a pin-on-disk friction apparatus incorporated in a metallurgical furnace. At room temperatures the results with steel, but not with the other metals, depended markedly on the atmospheric moisture content. As temperatures were raised to 400 C the friction and wear rate of the steel reached a maximum at 100 C and then diminished, while with the other metals the friction remained constant and the wear rate increased. These and other results are discussed in terms of the W/p ratio for the metals, W being the surface energy and p the hardness. It is postulated that materials with low W/p ratios should have favorable friction properties at high temperatures.

On the Mechanism of Gear Lubrication.....58—Lub-4

By V. N. Borsoff, Shell Development Company, Emeryville, Calif. 1958 ASLE-ASME Lubrication Conference paper (in type; to be published in Trans. ASME—*J. Basic Engng.*; available to Aug. 1, 1959).

Only a few decades ago it became apparent that the lubricant plays a very important part in gear operation and should be incorporated as a gear design factor. Unfortunately, however, the mechanism of gear lubrication was little understood and there were no generally accepted theories and rules. This state of affairs prompted research on the mechanism of gear lubrication. During 1953 to 1957 the work was carried out under the sponsorship of the Department of the Navy under the title, "Fundamentals of Gear Lubrication." The high lights and conclusions drawn are the subject of this paper. A large number of data were secured, and necessarily, these data are presented here in a condensed form. For the complete data of this research program the reader is referred to the progress reports made to the Bureau of Aeronautics of the Department of the Navy during the afore-mentioned period.

Scoring and wear of gears are evaluated as functions of various operating variables, gear geometry and construction factors, and lubricants properties. This is followed by a brief discussion of the results of experiments performed with tagged extreme-pressure lubricants showing distribution and thickness of the extreme-pressure films and the rates of their attrition. Based on all of these results, a mechanism of gear lubrication is postulated and discussed.

In experiments on oil jet velocity and the location of oil supply, nozzles were placed in locations 1, 3, 5, 7, 9. Two sizes of nozzles were used, one giving a jet velocity of 1.85 ft/sec. and the other 63.5 ft/sec. (58—Lub-4)

Sliding Wear and Metal Transfer Under Unlubricated Conditions .....58—Lub-9

By R. P. Steijn, E. I. du Pont de Nemours & Company, Wilmington, Del. 1958 ASLE-ASME Lubrication Conference paper (in type; to be published in Trans. ASME—*J. Basic Engng.*; available to Aug. 1, 1959).

To provide further information on dry sliding wear and the accompanying metal transfer, wear experiments of radioactive brass rings against hardened steel have been conducted in a ring tester. The effect on metal transfer of sliding speed, surface finish, material of the harder surface, and the presence of slots in the steel ring have been investigated. Tests have also been conducted in argon atmospheres to exclude oxidation.

1 The wear of brass on steel in a ring tester is primarily a process of transfer and subsequent removal of the transferred brass to form loose wear debris. Back transfer takes place simultaneously. However, its magnitude compared to transfer is very small, and the role which it plays in the over-all wear mechanism is of minor importance.

A small amount of direct wear from the brass ring is possible without violating the experimental data, but its occurrence can be neither proved nor disproved with the experimental techniques used.

2 Higher sliding speeds are accompanied by less wear and with a smaller equilibrium amount of transfer. Also, better surface finishes on the steel rings increase the equilibrium amount of brass transferred.

3 In argon the rates of wear are smaller than in air for all combinations of brass sliding on steel and brass sliding on brass. At the same time, the amount of transfer is larger in argon. This shows that galling of metals is not necessarily equivalent to wear of metals.

4 For brass against brass, relatively simple sliding arrangements obey the simple wear theory. For instance, on the Burwell tester, the two basic rules of wear are closely followed. However, if one ring is provided with slots, deviations from simple behavior become manifest at once. The discrepancies between the wear of the two rings increase as the geometries of the mating surfaces become more unlike. Yet, the total or combined wear remains constant.

5 It is concluded that the simple wear theory applies only so long as changing the geometry of the apparent area of contact does not affect the mode of removal of the transferred material. If this happens, the k factor (coefficient of wear) will change drastically, and predictions of wear will become exceedingly difficult. Thus it appears that the next advance in the study of wear must be made by a fuller understanding of the

effect of geometry on the removal of transferred material.

The Gas-Lubricated Sector Thrust Bearing.....58—Lub-5

By C. C. Mow and Edward Saibel, Mem. ASME, Rensselaer Polytechnic Institute, Troy, N. Y. (in type; to be published in Trans. ASME—*J. Basic Engng.*; available to Aug. 1, 1959).

For a number of years, much attention has been given to the possibility of using gas as a lubricant. Most of the work in this field, however, has been done for the incompressible case principally because of the mathematical complexity of the problem. The nature of this complexity involved in the compressible case is the nonlinearity in the basic differential equation. As a result, problems of this nature have not been fully investigated.

The object of this paper is to obtain an exact solution for a sector thrust bearing with side leakage and film variation in angular and radial direction, also taking into account the effect of compressibility of the gas.

An Accessory Manufacturer's Approach to Bearing and Seal Development .....58—Lub-10

By Stanley Gray, Fairchild Engine and Airplane Corporation, Bay Shore, N. Y. 1958 ASLE-ASME Lubrication Conference paper (multilithographed; available to Aug. 1, 1959).

The aircraft-accessory manufacturer, concerned with diverse products, is faced with many unusual bearing, seal, and lubrication problems. One approach to these problems is to take the best available information, simulate the operating requirements on test rigs, and evolve a satisfactory solution.

The investigations reported in this paper cover the following individual items considered to be of current interest:

1 Operation of bearings at speeds to 140,000 rpm with reference to lubricants suitable for bearing temperatures to 625 F and problems of wear and vibration.

2 Development of 1000 F bearings of several high-temperature materials with reference to the value of powdered lubricants, capacity, wear, and friction.

3 Oil throwaway lubrication of bearings at 800 F using conventional type lubricants.

4 The use of Freon-12 refrigerant in the liquid and vapor phases as a bearing lubricant at temperatures from −18 to +1000 F.

5 Development of a Freon-12 shaft seal design for an aircraft-type refrigeration compressor.

6 The dry operation of high-speed, high-temperature shaft seals.

Petroleum

Vibration of Vertical Pressure Vessels .....58—Pet-13

By C. E. Freese, Mem. ASME, The Fluor Corporation, Ltd., Los Angeles, Calif. 1958 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; to be published in Trans. ASME—*J. Engrg. for Indus.*; available to July 1, 1959).

This paper is primarily concerned with the vibration of vertical pressure vessels known as columns or towers.

The procedure for estimating the period of the first mode of vibration for columns which are the same diameter and thickness for their entire length is outlined. A graph is included for this purpose which recommends limits between vessels considered to be static structures and those considered dynamic.

A method for designing vessels considered as dynamic structures is described as well as a detail procedure for estimating the period of vibration of multithickness (stepped shell) vessels and/or vessels built to two or more diameters with conical transitions where the difference in diameter is small.

There is a brief résumé of the "Karman vortexes" effect and a discussion regarding vibration damping by liquid loading and the benefit of ladders and platforms which help reduce the effect of periodic eddy shedding.

The design procedure outlined will be useful to the practical vessel designer confronted with the task of investigating vibration possibilities in vertical pressure vessels.

Experience and Evaluation of Deep Groundbeds .....58—Pet-18

By R. L. Bullock, Interstate Oil Pipe Line Company, Shreveport, La. 1958 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1959).

The severe underground corrosion experienced on Interstate Oil Pipe Line Company's system in Central and Southwestern Mississippi made it necessary to employ cathodic protection. The high-resistance soil and scarcity of electric power lines limited the cathodic units to high current output rectifiers. Experience with rectifier-type units employing normal surface groundbeds, vertical graphite rods with coke-breeze backfill spaced 10 to 20 ft apart, proved very costly and unsatisfactory when installed in high-resistance soil. Search for pockets of low-resistance soil was disappointing but did reveal one location with low-resistance soil below a stratum of high-resistance surface soil. The installation of a single vertical steel groundbed, deep enough to penetrate into the deep zone of low-resistance soil, was successful. The low circuit resistance and long protective spread obtained by this unit led to the in-

Groundbed is installed in a step-by-step method. *Left to right*, graphite rod with stud, first step; casing lowered over graphite rods and bonding joints of casing, second step. (58—Pet-18)

Analysis and Characteristics of the Three-Lobe Bearing.....58—Lub-2

By O. Pinkus, Mem. ASME, General Electric Company, West Lynn, Mass. 1958 ASLE-ASME Lubrication Conference paper (in type; to be published in Trans. ASME—*J. Basic Engng.*; available to Aug. 1, 1959).

The requirements of industry to run bearings at ever-increasing speeds and at conditions that often cause shaft instability brought about the use of radical bearing designs like the elliptical tilting shoe, and other forms of journal bearings. However, the 3-lobe bearing, due mainly to its complex geometry, remained unpopular as well as unexplored but, as shown by experiments and as corroborated by the analysis in this paper, it is one of the most stable bearings. Furthermore, despite the large lobe clearances, the 3-lobe bearing is extremely rigid which in many applications, like in the case of gears, is paramount.

An analytical solution of 3-lobe journal bearings is offered based on the solution of the finite Reynolds equation. Expressions for eccentricity, lubricant flow, power loss, and spring constant are given for a range of L/D ratios and ellipticities. The bearing is shown to be of superior quality both in its stability characteristics and in its hydrodynamic performance. Charts and equations for setting design requirements and calculating performance are given.

Elastic and Damping Properties of Cylindrical Journal Bearings.....58—Lub-3

By B. Sternlicht, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1958 ASLE-ASME Lubrication Conference paper (in type; to be published in Trans. ASME—*J. Basic Engng.*; available to Aug. 1, 1959).

The knowledge of hydrodynamic damping and elastic properties of journal bearings is desirable for the accurate determination of the critical speed of a shaft and for the anticipation of its behavior in the neighborhood of such speeds. It is also required for judging the stability of the rotating shaft against self-excited vibrations.

The equations that describe the motion of the journal center may be given by a differential equation.

The stiffness and dissipation functions in this equation are dependent on Sommerfeld numbers and therefore, in turn, on the eccentricity ratio. This paper gives values for these parameters as functions of eccentricity ratio. These parameters are determined from the solution of Reynolds two-dimensional equation with squeeze-film considered.

The paper is divided into four parts: (*a*) Derivation of the equations; (*b*) consideration of special cases; (*c*) solution with arbitrary direction for the squeeze-film velocity; (*d*) conclusions and recommendations.

stallation of other deep-groundbed units. The successful installation of a deep groundbed in high-resistance soil proved that although low-resistance soil is preferred it is not necessary in order to obtain a low-resistance groundbed. The disadvantage of a six to seven year life expectancy of steel-type deep groundbeds was offset by the development of a deep-graphite coke-breeze back-fill groundbed with a life expectancy of 20 or more years.

The purpose of this paper is to review the development and installation of the deep-graphite coke-breeze backfilled groundbed and to evaluate its performance.

Drilling by Vibration...58—Pet-21

By R. Simon, Battelle Memorial Institute, Columbus, Ohio. 1958 ASME Petroleum Mechanical Engineering Conference paper (in type; to be published in Trans. ASME—*J. Engng. for Indus.*; available to July 1, 1959).

Drilling by vibration is accomplished by superimposing longitudinal vibrations, at some frequency in the range of about 100 to about 1000 cycles per second, onto the drill bit of an otherwise conventional rotary drilling system.

A number of laboratory and field models of vibratory drilling machines have been designed, constructed, and used in experimentation. The latest version encompasses a magnetostriction transducer that follows a 10½-in-diam rotary bit down the drilled hole.

The basic feature of all the models of vibratory drilling systems is a column which is vibrated longitudinally at or near the resonant frequency of its fundamental mode. One end of the column is essentially free, as far as the vibrations are concerned, and the other end is loaded by the bit acting on the rock. Since the effective impedance of this load is small compared with the characteristic impedance of the column, the fundamental mode of vibration of the column is close to that of a free-free bar, one half wavelength long.

Magnetostriction transducers were employed to drive the vibrating column for most of the experimental work in vibratory drilling, although some preliminary work was done with electrodynamic transducers. Use of electroacoustic devices to generate the vibrations affords the distinct advantage of the absence of sliding or rolling bearing surfaces which must be sealed off from the abrasive drilling fluid. On the other hand, they require means for generating and controlling up to about 200 kw of electric power and for transmitting it down the drill string. The magnetostriction transducer is more readily adapted to the requirements imposed by operation down a hole being drilled than the electrodynamic transducer, considering the limitations on lateral dimensions and the need for transmitting large steady forces and torques through the transducer.

The purpose of this paper is to present a comprehensive theory of vibratory drilling, in which the interaction between the load and the transducer is taken into account in determining performance. The theory presented in this paper is developed for the case of a magnetostriction transducer, but the same analytical techniques would be applicable to the uses of other types of transducers.

A New Analytical Approach to Drill-Pipe Breakage....58—Pet-12

By J. L. Bogdanoff, Mem. ASME, and J. E. Goldberg, Midwest Applied Science Corporation, Lafayette, Ind. 1958 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1959).

Costs of drilling a well represent a substantial fraction of total well cost. Any effort, theoretical or experimental, which can contribute to a reduction in breakage or which can illuminate the essential

features causing breakage is of considerable economic value to the oil producing industry.

The stress distribution in a drill pipe in rotary drilling is determined by the method of drive, the forces acting on the bit, and by the forces arising from contact of the pipe with the sides of the hole. The number of factors needed to describe in detail the stress distribution at any one instant of time is large and some are not known. Also, the relative importance of many of these factors is likely to change as a hole deepens and from well to well.

This paper is devoted to a study of the statistical properties of the shear and normal stress in a drill pipe which is driven at one end in a fairly general fashion and subject at the other end, i.e., at the bit, to torque and axial force. The model chosen for the initial study is the simplest deterministic one possible; only axial and torsional displacements are considered, the pipe has a constant length and a uniform circular cross section, and viscous damping is uniformly distributed along the length. The essential novelty in this paper is in the assumption that the fluctuating torque and axial force at the bit are random in nature. That this assumption is reasonable follows from the erratic behavior of bits when cutting brittle material.

Formulas are derived for variances of shear and normal stresses and for the probability of these stresses exceeding an arbitrarily specified stress level. Experiments are recommended for obtaining basic statistical data needed in carrying out the evaluation of the formulas.

The Strength of Thick-Walled Cylinders.....58—Pet-20

By B. Grossland and J. A. Bones, University of Bristol, Bristol, England; and S. M. Jorgensen, Foster Wheeler Corporation, New York, N. Y. 1958 ASME Petroleum Mechanical Engineering Conference paper (in type; to be published in Trans. ASME—*J. Engng. for Indus.*; available to July 1, 1959).

Comprehensive pressure tests have been carried out on thick-walled, closed-ended cylinders made from a mild steel and a hardened and tempered steel, the maximum pressure reached being 94,000 lb/in. The complete theoretical behavior of the cylinders is computed from shear stress-strain data obtained from torsion tests and is shown to be in very close agreement with the experimental results. In addition, a method is given for deriving the large strain behavior of the cylinders from tension test data. When compared with the experimental results this approach gives larger errors, the theoretical values of pressure being consistently high. Finally, ultimate pressures have been calculated from two empirical expressions.

Strength of Welded Joints in Low-Alloy Steels at Elevated Temperatures .....58—Pet-34

By W. B. Hoyt, The M. W. Kellogg Company, New York, N. Y. 1958 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1959).

The tendency of high-temperature failures in pressure equipment to take the form of cracks adjacent to welded seams has posed the question: "Is there an inherent weakness in any portion of a welded joint at elevated temperatures?" In an effort to answer this question partially a Task Group of the Petroleum and Chemical Panel of the Joint ASTM-ASME Research Committee on the Effect of Temperatures on the Properties of Metals has been conducting a limited program of testing. The first phase of this program was conducted on weldments in carbon steel and was reported in ASME paper No. 57—Pet-1, a digest of which appeared in MECHANICAL ENGINEERING, Nov., 1957, p. 1064.

The second phase of the program concerns similar tests on weldments of 1 per cent Cr-$^1/_2$ Mo and 2$^1/_4$ per cent Cr-1 per cent Mo steels. These alloy-steel weldment tests, as reported here, have indicated the desirability of certain supplementary investigations to clarify the significance of some of the results. This additional work is in progress and will be the subject of a supplementary report at a later date.

As was the case with the previously reported work on carbon-steel weldments, this investigation was restricted to a basic evaluation of the strength of composite specimens including weld, heat-affected metal, and base metal, exclusive of any effects of mechanical notches, reinforcement, flaws, undercuts, and so forth.

Survey of Operating and Maintenance Expenses for Small Skid-Mounted Compressor Units.....58—Pet-36

By P. B. Edmondson, Mem. ASME, The Atlantic Refining Company, Dallas, Texas; and Harry Evans, Mem. ASME, Sinclair Oil and Gas Company, Tulsa, Okla. 1958 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1959).

The increasing value of natural gas over the past few years has focused the attention of producers, and to a lesser extent of transmission companies, on small isolated volumes which previously were flared or shut in. State regulatory bodies have as a conservation measure effectively opposed indiscriminate flaring. These factors have resulted in the installation of many small compressor stations for gas lift and pressure maintenance service as well as for direct sale.

Equipment suppliers have responded to this need by offering a full line of units covering sizes from 30 bhp up, with a variety of drive arrangements and with any desired degree of shop assembly or "packaging." The mechanical engineer need have no difficulty in finding equipment to meet his conditions. His problem will more likely be that of wise selection with due regard to both capital and operating costs.

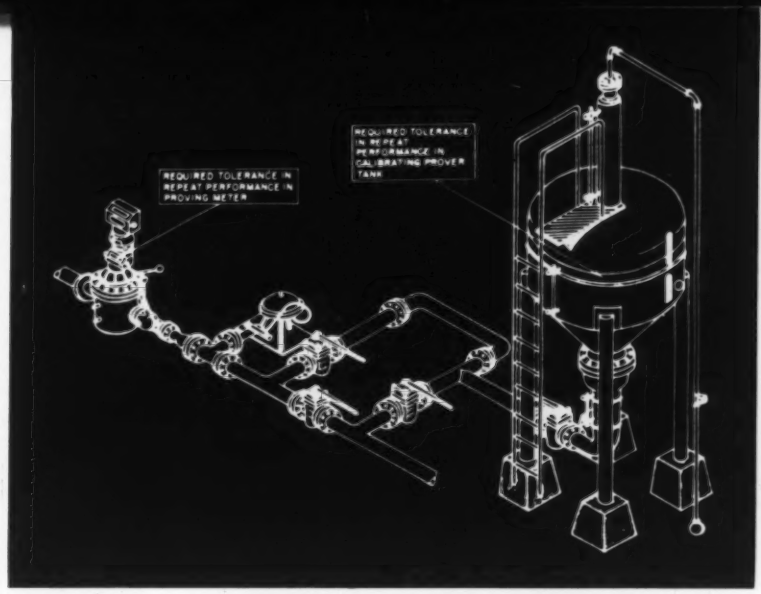
Initial investment costs can be estimated with reasonable accuracy presuming effort and skill on the part of the estimator. On the other hand, the realm of operating costs is more intangible and one in which the engineer must either patiently build his own records or rely to a great extent on the experience of others. This paper is intended to correlate the available operating cost data of several companies that operate compressors in the 50–880 bhp class. Best coverage is in the class below 400 bhp.

Packaged Compressor Plants Earn Their Popularity.....58—Pet-35

By R. W. Evans, The Stearns-Roger Manufacturing Company, Denver, Colo. 1958 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1959).

Compressors are the key to movement of gases and thus play the star role in the equipment cast for processing plants of all types. The project may be related to pipelining, commercial distribution, production, recycling, secondary recovery, gas gathering, combustion drive, or gas processing. In each of these broad fields, however, the usual experience has been that gas at controlled pressure and temperature is a prime requisite. For this duty, compressors have provided the answer, and they have grown and developed at a sufficiently rapid rate to keep pace with the ever-expanding and improving oil and gas industry.

The development of relatively lightweight, compact integral compressors made "packaged compressor plants" possible. These packaged compressor plants are complete operating units incorporating all necessary equipment, piping, and accessories required for satisfactory operation. Flexibility, portability, short field construction time, and high salvagability have made the installed cost per bhp lower than for block-mounted units. Packaged compressor plants have earned their place in the modern world.


REQUIRED TOLERANCE IN REPEAT PERFORMANCE IN CALIBRATING PROVER TANK
REQUIRED TOLERANCE IN REPEAT PERFORMANCE IN PROVING METER

Positive-displacement (PD) meter measurement procedure has fewer possible sources of error than tank-gaging procedure (58—Pet-10)

Experience With PD Meters and Fixed-Volume Tank-Measurement Procedures in LACT.....58—Pet-10

By L. S. Wrightsman, Mem. ASME, Humble Pipe Line Company, Houston, Texas. 1958 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1959).

The purpose of this discussion is to present as clearly as possible the viewpoints of the pipeline industry toward automatic measurement procedures involved in the custody measurement of receipts into a pipeline gathering system from the producer's lease tankage. Actual experience with positive-displacement (PD) meters and fixed-volume tank-measurement procedures in making such measurements is also covered, as well as a comparison of one method with the other. There have been a number of articles in various trade journals in the past year or more which indicate that the use of lease automatic custody transfer (LACT) is expanding quite rapidly, and, if present trends continue, the old, long-established hand gaging procedure may be replaced in many cases by automatic measurement.

The favorable attitude of a representative group of pipeline operators toward the use of lease automatic custody transfer measurement procedures is presented, as well as reasons why the pipeline industry seems to favor measurement by this procedure. The economics, improved measurement accuracies, and the improved efficiency of gathering systems indicated by experience with positive-displacement meters and fixed-volume measuring-tank procedures are cited as the reasons. It appears that the reasons and advantages cited indicate that the use of LACT will expand very rapidly in the immediate future.

Fluid Knock in Oil-Field Mud Pumps Due to Separation.....58—Pet-5

By S. L. Collier, Mem. ASME, Mission Manufacturing Company, Houston, Texas. 1958 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1959).

Knocking results in a limitation on the use of the mud pump; it would be desirable to remove this limitation. In order to make a complete analysis of this problem, it is necessary to have both completely controllable equipment and high-response instrumentation that will record the phenomena.

This paper describes a study of the sounds emanating from an oil-field pump. Most of the sounds or knocks are mechanical and are relatively easy to isolate, but one sometimes identified as valve knock is not as well understood. Various detailed experiments were made to establish the characteristics of this knock definitely. These include the behavior of the valves, the fluctuation of pump-suction pressure, the variation of velocity in the suction, and the speed of propagation of the suction-pressure waves. These tests established the fact that this is a hydraulic knock and that it occurs when the pump operation causes the development of a void in the cylinder. When the void is filled, usually just past mid-stroke, the liquid strikes the piston causing a hydraulic shock wave and loud knock.

Applied Mechanics

The Effect of Product of Inertia Coupling on the Natural Frequencies of a Rigid Body on Resilient Supports .....58—A-9

By C. E. Crede, Mem. ASME, Barry Controls, Inc., Watertown, Mass. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.*; available to Oct. 1, 1959).

In the application of vibration isolators, the theory of a rigid body on resilient supports is often used to evaluate the performance of the isolators. The general condition involves six degrees of freedom but, in the absence of symmetry, the resulting equations are too cumbersome for practical engineering use. By assuming certain kinds of symmetry, these equations can be used to solve a wide range of engineering problems. A common condition which approximates many actual applications is one involving two vertical planes of symmetry wherein the principal axes of inertia of the rigid body are respectively parallel to the principal elastic axes of the resilient supports. The determination of the natural frequencies of such a system has been made a simple engineering calculation by the methods set forth elsewhere.

A system is encountered occasionally which meets the requirements of symmetry in so far as the center of gravity of the rigid body and the locations of the isolators are concerned but wherein the symmetry does not extend to the principal axes of inertia. This may result, for example, from an unsymmetrically located heavy component within the rigid body which causes the principal axes of inertia to be inclined with reference to the general outlines of the body. The product of inertia which can be neglected when the supported body is symmetrical must then be considered.

This paper is concerned specifically with a rigid body supported by resilient supports located underneath the body. The system has a single vertical plane of symmetry. It will be shown that horizontal translational and rotational motions of the body in one of the vertical planes are coupled, and that similar coupling occurs in the other vertical plane. For motion in the horizontal direction perpendicular to the plane of symmetry, the product of inertia of the body causes additional coupling to rotational motion about the vertical axis. A method is developed for determining the natural frequencies in these three coupled modes, employing a procedure of sufficient simplicity to be useful for engineering purposes.

A Refined Theory of Elastic Orthotropic Plates.....58—APM-16

By S. J. Medwadowski, Assoc. Mem. ASME, University of California, Berkeley, Calif. 1958 West Coast Conference of the Applied Mechanics Division paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Aug. 1, 1959).

A refined theory of elastic, orthotropic plates is presented. The theory includes the effect of transverse shear deformation and normal stress and may be considered a generalization of the classical theory of von Karman modified by the refinements of the Lévy-Reissner-Mindlin theories. A nonlinear system of equations is derived directly from the corresponding equations of the three-dimensional theory of elasticity in which body-force terms have been retained. Next, the system of equations is linearized and reduced to a single sixth-order partial differential equation in a stress function. A Lévy-type solution of this equation is discussed.

Plastic Stress-Strain Relationships—Some Experiments on the Effect of Loading Path and Loading History .....58—A-11

By S. S. Gill and J. Parker, University of Manchester, Manchester, England. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

Tests have been carried out on thin closed-ended tubes of alpha brass subjected to various combinations of torque and internal pressure. The effect of loading, unloading, and reloading along different loading paths has been investigated, including the effect on the shape of the yield surface, and the form of the curve of representative stress and representative strain. The behavior of the material for initial loading suggests that the material is isotropic in the plane of the surface of the tube but is anisotropic in a radial direction. A form of yield criterion and representative stress which correlates these results has been deduced, but the results of the tests for the second loadings of the specimens cannot be correlated in terms of a nested set of similar yield surfaces. The evidence for or against the existence of corners or pointed vertexes on the yield surface is inconclusive.

Stress Distribution and Plastic Deformation in Rotating Cylinder of Strain-Hardening Material..... .....58—A-10

By E. A. Davis, Mem. ASME, and F. M. Connelly, Westinghouse Research Laboratories, Pittsburgh, Pa. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

Equations for the stress distribution in plastic rotating cylinders are developed for both hollow and solid cylinders. It is assumed that the stress-strain relations may depend upon either the maximum shearing stress or the octahedral shearing stress and the corresponding shearing strain. A triaxiality factor proportional to the ratio of the hydrostatic tension to the octahedral shearing stress is introduced. This factor may be useful in evaluating the ductility of metals under combined stress.

Forced Torsional Vibration of Systems With Distributed Mass and Internal and External Damping... .....58—A-8

By K. E. Bisshopp, Rensselaer Polytechnic Institute, Troy, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

This analysis extends similar results previously obtained in a paper by Den Hartog and Li, see *Journal of Applied Mechanics*, vol. 13, Trans. ASME, vol. 68, 1946, pp. 276–280, where the remainder torque is calculated at one end of a homogeneous system. Comparative computations made there with complex Holzer tables show excellent agreement with results obtained from the theory of distributed systems. The general boundary-value problem, including the response to an externally applied torque at any section, is solved in this paper. The special case of a homogeneous engine system with a flywheel at one end is analyzed in detail. The theory is illustrated with comparative computations using complex Holzer tables for such a system with external torque applied at a section remote from the ends. Again, numerical results obtained by both methods are in excellent agreement.

Natural Forcing Functions in Nonlinear Systems.....58—A-6

By T. J. Harvey, Lockheed Missile Systems Division, Palo Alto, Calif. 1958 ASME Annual Meeting paper (published in Trans. ASME—*J. Appl. Mech.*, September, 1958; available to Oct. 1, 1959).

The response of nonlinear, second-order systems is examined from a new point of view which greatly simplifies presentation of the usual frequency-response diagrams. The use of "natural" forcing functions results in a general equation relating the maximum amplitude of the applied force to the maximum amplitude of the restoring force. The relationship is found to be a function of the ratio of the period of free oscillation to the period of the forcing function. The results apply for any second-order system without damping and with a nonlinear (or linear) restoring force. The special cases of a linear system and of Duffing's equation are considered to illustrate similarities as well as differences between treatment of linear and nonlinear frequency-response problems.

The Effect of Spin Upon the Rolling Motion of an Elastic Sphere on a Plane.....58—A-5

By K. L. Johnson, University of Cambridge, Cambridge, England. 1958 ASME Annual Meeting paper (published in Trans. ASME—*J. Appl. Mech.*, September, 1958; available to Oct. 1, 1959).

The motion and deformation of an elastic sphere rolling on an elastic plane are examined for the case when the sphere, in addition to its straight rolling motion, has an angular velocity of "spin" Ω about an axis normal to the plane. The action of spin is to twist the area of contact. Surface tractions resulting from this rotation are found, which demonstrate the necessity of partial slip in the area of contact. Previous investigations suggest that this slip cannot occur at the leading edge of the contact circle, so that a system of tractions is found which corresponds to zero stress at the leading point. It is shown that such a system of tractions gives rise to a transverse creep of the sphere in the direction of its rotation Ω. The magnitude of this creep is calculated for small values of Ω, when slip occurs to only a small extent. Experiments have been performed using a simple thrust bearing with plane parallel races As the bearing rotates, the balls creep radially outward in the predicted manner. Quantitative measurements of this creep agree with the theoretical estimate over a wide range.

Ducted Fan Design Theory. 58—A-4

By C. G. Van Niekerk, National Mechanical Engineering Research Institute, South African Council for Scientific and Industrial Research, Pretoria, Union of South Africa. 1958 ASME Annual Meeting paper (published in Trans. ASME—*J. Appl. Mech.*, September, 1958; available to Oct. 1, 1959).

A theory is outlined by means of which it is possible to design ducted fans directly and without having to choose any parameters in an arbitrary fashion. Optimum sizes and fan speeds are theoretically determined. The design of two fans, one having inlet guide vanes and the other of the low slip-stream-rotation type having NPL straighteners and often used in wind tunnels, are considered by way of example. While achieving a considerable degree of rationality, the theory introduces a

concept of annulus efficiency that is still of an empirical nature. The empiricism is due to a present lack of knowledge about three-dimensional fan losses, and suggests further investigation.

More results of experimental investigations will have to become available if fans are to be more rationally and effectively designed. In particular, as pointed out in the present analysis, considerably more information is required about fan losses, and also about such cascade-flow phenomena as are peculiar to fans.

In view of the increasing use of ducted fans, not only in the realm of aeronautics but also for ventilating work, further investigations may well be considered justified.

Unsteady Laminar Boundary Layers in an Incompressible Stagnation Flow.....58—A-3

By Kwang-Tzu Yang, Assoc. Mem. ASME, University of Notre Dame, Notre Dame, Ind. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.*; available to Oct. 1, 1959).

This study deals with unsteady laminar boundary layers in the immediate vicinity of the stagnation point of a heated blunt-nosed cylinder in an incompressible flow with unsteady velocity. An exact solution is presented for the special case of a flow velocity varying inversely with a linear function of time, together with calculated boundary-layer characteristics for different values of a flow parameter. Based on the results of this exact solution, an approximate method of solutions is proposed for a more general problem where the flow velocity changes arbitrarily with time. The results of five examples are shown and discussed in the light of other available solutions. Finally, the limitation of this approximate solution is pointed out and a possible remedy indicated.

Analysis of the Thermoelectric Effects by Methods of Irreversible Thermodynamics.....58—A-1

By G. N. Hatsopoulos and J. H. Keenan, Fellow ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.*; available to Oct. 1, 1959).

By means of the thermodynamics of irreversible processes three thermoelectric quantities, namely, the Thomson coefficient, the Peltier coefficient, and the electromotive force of a thermocouple, are each expressed in terms of a pure temperature function h which is the difference between the isothermal energy flux in a conductor per unit electrical current and the electrochemical potential of the unit electrical charge. The Kelvin relations for the thermocouple follow directly.

The Effect of a Tangential Contact Force Upon the Rolling Motion of an Elastic Sphere on a Plane.58—A-7

By K. L. Johnson, University of Cambridge, Cambridge, England. 1958 ASME Annual Meeting paper (published in Trans. ASME—*J. Appl. Mech.*, September, 1958; available to Oct. 1, 1959).

The motion and deformation of an elastic sphere rolling on an elastic plane under a normal contact pressure N have been studied for the case where a tangential force T is also sustained at the point of contact. Provided that $T < \mu N$ (μ = coefficient of friction), the sphere rolls without sliding, but exhibits a small velocity relative to the plane, termed "creep." Following the work of Mindlin and Poritsky, it is shown that creep arises from slip over part of the area of contact, and further, that this slip takes place toward the trailing edge of the contact area. On the assumption of a locked region in which no slip occurs, of circular shape, tangential to the circle of contact at its leading point, surface tractions are found which satisfy the condition of no slip within the locked region and are approximately consistent with the laws of friction in the slip region. The variation of creep velocity with tangential force is thereby determined. Experimental measurements of the creep of a steel ball rolling on a flat steel surface are in reasonable agreement with the theoretical results.

Heat Transfer

Void Volumes in Subcooled Boiling Systems.....58—HT-19

By P. Griffith, Assoc. Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass.; J. A. Clark, Assoc. Mem. ASME, University of Michigan, Ann Arbor, Mich.; and W. M. Rohsenow, Massachusetts Institute of Technology, Cambridge, Mass. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

An experimental investigation was conducted to determine the void volume in a subcooled boiling system. The results of studies of void volumes in systems of 500 psia, 1000 psia, and 1500 psia are presented.

Basically the procedure used was to fix the heat flux, velocity, and pressure on a surface in boiling and photograph it. The bubbles on the photograph were then measured, and counted, and the void volume calculated.

A semiempirical method of predicting the void volumes is presented. A comparison of measured and predicted void volumes is made with data collected at 2000 psia under completely different conditions.

Two-Phase Pressure Drop for Horizontal Crossflow Through Tube Banks.....58—HT-20

By J. E. Diehl and C. H. Ruh, C. F. Braun & Company, Alhambra, Calif. 1958 ASME-AIChE Joint Heat-Transfer Conference paper (multilithographed; available to June 1, 1959).

Two-phase horizontal crossflow through tube banks is encountered in many processing plants today. Examples are condensers and reboilers, and such petroleum-refinery services as catalytic reformer and pretreater exchangers, and rich absorption oil preheaters. Two-phase pressure drop is one of the important factors in the design of these exchangers.

This paper reports a study of pressure drop for horizontal crossflow of two-phase gas-liquid mixtures through four tube banks with horizontal tubes. Two tube banks have staggered-tube layouts, 60 and 45 deg. The other two have in-line or 90-deg tube-field layouts.

Test systems studied were air-water and pentane vapor-pentane liquid. A pressure-drop correlation is developed for horizontal two-phase crossflow through tube banks. Correlating parameters are the fictitious all-gas pressure drop, the liquid-volume fraction, and the ratio of the gas and liquid densities. The predicted pressure drops have an average deviation from measured values of plus or minus 12 per cent; and nine tenths of all test points fall within plus or minus 24 per cent of the correlating curves. The correlations can be used to estimate condensation pressure drop. Condensation test data are predicted within a maximum deviation of plus or minus 30 per cent. The average deviation is 16 per cent.

An Experimental and Analytical Study of Vortex-Flow Temperature Separation by Superposition of Spiral and Axial Flow.....58—A-90

By J. E. Lay, Assoc. Mem. ASME, Michigan State University, East Lansing, Mich. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME; available to Oct. 1, 1959).

An experimental and analytical study of compressible flow in a vortex tube is reported in this paper. Its purpose is to provide a better understanding of the separation of a gas stream into regions of

high and low stagnation temperatures, there being at present little agreement as to the theory of operation.

Part I reports on the experimental study. A large, multipurpose vortex tube is designed and built so that velocity, pressure, and temperature traverses can be taken at different stations along the length of the tube. Data are taken for runs at different inlet pressures, sizes of cold air orifice, and amounts of exit throttling. Flow visualization is also obtained by means of liquid injection.

Part II reports on the analytical study. The free vortex motion of the gas upon entrance to the tube is mathematically superposed to a compressible sink to give a spiral flow in the plane. The characteristic existence of limit circles is corroborated by the experimental flow visualization. The solution in space is obtained by addition of a uniform axial velocity to the spiral flow. When viscosity effects are considered, the free vortex is shown to change into a forced vortex. The latter flow is one of minimum kinetic energy and maximum entropy. Energy considerations enable the determination of an optimum cold air radius to give largest stagnation temperature separation. Significantly, this was the radius that gave best performance in the experimental program.

Railroad

Low Carbon-Intermediate Manganese Constructional Steel Castings .....58—A-185

By R. D. Enquist, American Steel Foundries, East Chicago, Ind. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The successful use of the low carbon-intermediate manganese composition to combat brittle fracture and yet meet existing mechanical-property specifications for commercial cast steels depends on a judicious balance of alloying elements. Several investigators have shown that impact transition temperature varies directly with carbon content and inversely with manganese content. This implies that a reduction of carbon content and an increase in manganese content result in a lowering of impact transition temperature. Transition temperature may be defined as that point or temperature range at which fracture ceases to occur by a shear mechanism and commences to occur by a cleavage mechanism. It may be considered an index of the tendency of a material to fail by brittle fracture when such other pertinent factors as notch geometry and rate of load application are held constant as may be done in a laboratory test.

The paper describes the engineering properties of low carbon-intermediate manganese cast steels. Ductility, toughness, fatigue characteristics, weldability, and machinability are discussed. Production data from many commercial heats are presented together with discussion of test data from actual castings.

The Economics of Reclamation of EMD 567 Engine Cylinders With Porous Chrome.....58—A-186

By J. M. A. Van der Horst, Mem. ASME, and Russell Pyles, Mem. ASME, J. M. A. Van der Horst Corporation, Olean, N. Y. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The reclamation of the bore of 567 cylinder liners with porous chrome has been a standard practice with most Class 1 railroads for a number of years. Although the rate of wear of porous chrome-plated liners has generally been found to be a fraction of the rate of wear of cast-iron liners, it has been advanced recently that other factors may influence the actual life of porous chrome-plated liners unfavorably to the extent that the service life of a plated liner does not exceed that of a cast-iron one. The purpose of this paper is to investigate (*a*) the validity of the influence of those unfavorable factors, and (*b*) the possibility of taking additional measures which would influence favorably the service life of porous chrome-plated liners.

Glass-Fiber Banding of Traction-Motor Armatures.....58—A-173

By E. C. Appleby, Mem. ASME, Westinghouse Electric Corporation, East Pittsburgh, Pa. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The development of glass fiber-reinforced plastics has made available a material that is revolutionizing the art of armature banding. Conventional wire bands for traction-motor armatures, which have been highly developed in the past few years, are rapidly being replaced by bands made from glass tape. The tape is made of nonwoven, parallel, glass-fiber yarns impregnated with polyester resin and semicured. The tape is in flat form, thus permitting the parallel yarns of the tape to share the load equally. The bands are formed by wrapping the tape, under considerable tension, directly onto the coils of an armature. A sufficient number of turns of tape is applied to produce a band which will be stressed to a preselected design value. After the band is formed, the polyester resin is cured by heating. The final result is a solid band of amazing strength which adheres tightly to the coils, yet does not bond, and has a high strength-to-weight ratio. The glass band is economical, reliable in service, and safer to apply than wire.

In this paper the band made of glass fiber is analyzed and compared to the wire band. Comparison is made of theoretical coil movement and the importance of prestressing glass-fiber bands is explained. Comparative test results covering retained-tension, tensile strength, end termination, and aging data are presented. The application of this type of band and service experience obtained are also discussed. In the interest of simplicity the word "glass"

Traction armature having glass-fiber band applied (58—A-173)

is used in place of "glass fiber" throughout the paper.

Review of the Development of Draft Gears.....58—A-229

By N. Y. Olsen, Mem. ASME, Peerless Equipment Company, Chicago, Ill. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

After reviewing the general subject of the development of draft gears, the author discusses the present state of the draft-gear art and summarizes the situation as follows:

1 We will continue the use of standard 24⅝-in. pocket gears for years to come, obtaining protection up to 4 mph.

2 For higher pay loads we will use the 36-in. gear, obtaining protection up to 8 mph.

3 For excessive high-premium lading the sliding or cushioned underframe will be used, obtaining protection up to 12 mph.

Fuels

Design Considerations for Pneumatic Coal-Handling System.....58—Fu-2

By Walter Gruca, Assoc. Mem. ASME, Standard Forgings Corporation, East Chicago, Ind. 1958 ASME-AIME Joint Solid Fuels Conference paper (mulitlithographed; available to Aug. 1, 1959).

A 30-ton-per-hour-capacity pneumatic coal conveyer is described in this paper.

This conveyer is of the pressurized type. The conveyed material is fed into the conveying system which is operating above atmospheric pressure. A 200-hp positive-displacement rotary blower furnished 6500 cfm or 29,250 lb of conveying air per hr. Operating air pressure varies from a minimum of 1½ psi with no coal in the system to a maximum of 6½ psi when conveying to the most distant hopper.

Coal is discharged into the air stream by means of an 18-in-diam, 22-in-wide pocketed rotor with six pockets rotating in a closely fitting housing. The pipeline is 12-in. diam with straight lengths composed of 0.76 wall cast-iron pipe and bends made of 12-in. 0.50-wall standard steel pipe. The over-all length of the pipeline is 469 ft from the entry point to discharge at the farthest hopper.

With a conveying system of this nature, the coal hoppers are necessarily dust-tight with no openings to atmosphere except through a dust collector.

The operating sequence of the system and system performance are discussed. Detailed treatment is given to the rotary feeder, the pipeline, diverter valves, and the dust collector.

First Cyclone Furnace Boiler in Southeast .....58—Fu-3

By W. Bross, Mem. ASME, Greenwood Mills, Greenwood, S. C. 1958 ASME-AIME Joint Solid Fuels Conference paper (multilithographed; available to Aug. 1, 1959).

The cyclone furnace boiler, its operation, its advantages, and weaknesses, are discussed in this paper.

The boiler unit is 300,000-lb-per-hr, pressurized furnace equipped with two seven-foot cyclone furnaces. Design pressure is 1025 psi, design temperature at superheater outlet is 900 F.

Essentially, the cyclone furnace is a water-cooled horizontal cylinder which burns coal at combustion rates exceeding 400,000 Btu per cu ft per hr with gas temperatures of 3000 F and above.

Before the coal is fed into the vortex, it is first passed through a hammer-mill-type crusher and sized to where 95 per cent is less than one quarter inch size. The crushing process usually results in some seven to twelve per cent of the coal being fine enough to pass through a 200-mesh screen. This degree of fineness lends quick ignition properties to the cyclone.

Experience has shown that the cyclone furnace boiler:

1 Has not only been most satisfactory for efficient and dependable steam generation, but also reduces the number of major boiler auxiliaries needed in coal preparation, ash handling, and combustion air systems.

2 By eliminating equipment, electrical switch gear, controls, and foundations, requires less space and reduces construction and installation costs.

3 Due to the higher efficiencies obtained, provides greater economy in operation.

4 Reduces air pollution to a minimum without expensive collecting systems.

5 Produces ash which is relatively clean, easy to handle and dispose of, and which can be put to some useful, and in some instances profitable service.

6 Can burn so-called lower grade fuels—an advantage where freight rates are favorable to using high ash content fuels.

7 Combines safety and dependability with simplicity of operation—lowering personnel requirements and greatly improving employee attitude.

8 Reduces necessary maintenance to a minimum. That which is required is relatively simple and does not require special maintenance skills or personnel.

Oil and Gas Power

A Study, Using Radioactive Lubricating Oil, of the Rate of Oil Consumption in an Operating Diesel Engine.....58—A-143

By M. Poberskin and D. N. Sunderman, Battelle Memorial Institute, Columbus, Ohio; and E. J. Fithian, Cooper-Bessemer Corporation, Mount Vernon, Ohio. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Six experiments on lubricating-oil consumption, using radioactive oil, were conducted on a Cooper-Bessemer FW-6-T diesel engine. From the data, the following conclusions were drawn concerning the influence of various operating conditions on lubricating oil consumption:

1 It was found that the rate of oil consumption did not change during an entire 100-hr run-in period. If the early high piston-ring wear period does exist, it apparently has no relation to oil consumption.

2 Lubricating-oil consumption was investigated as a function of engine speed and load resulted in increasing oil consumption, while simultaneously increasing the oil temperature and water-jacket temperature decreased the rate of oil consumption.

3 Two experiments were conducted under identical operating conditions, but with the top oil ring removed from all pistons in one case. With the top oil rings removed, there occurred a noticeable increase in the rate of oil consumption.

The experiments, in general, proved the feasibility of the tracer method in determining the rates of lubricating-oil consumption as a function of operating conditions. On the other hand, no indication of a correlation between the rate of wear and the rate of oil consumption was found. From this experiment, it was indicated that early wear is largely independent of oil consumption.

Formation of Pressure Pulses by Exhaust Blowdown....58—A-145

By A. W. Hussmann, The Pennsylvania State University, University Park, Pa.; and W. A. Pullman, English Electric Company, Ltd., Rugby, England. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The discharge of gases from an engine cylinder into any exhaust manifold generates a blowdown pulse. The reflection of this fundamental wave at the open end of the manifold causes a wave motion which can have a great influence upon the scavenge air flow

through the cylinder. A method is described for determining the rate of cylinder blowdown and the form of the fundamental pulse. The relationship between the wave motion in the manifold and the variation in scavenge air flow is discussed, and experimental data are presented. A method of determining the energy content of the blowdown pulse is given so that the efficiency of blowdown under different conditions can be assessed.

Suppression of Engine-Exhaust Noise.....58—A-144

By Roy Kamo, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The exhaust noise from an internal combustion engine represents the largest single noise source which must be analyzed intelligently for effective noise control. The quieting of a diesel or gasoline engine exhaust involves complex engineering and acoustic problems. While many commercial mufflers appear to have been developed by empirical methods, the analytical approach to the behavior of exhaust noise and its suppression would represent a major advance for the engine accessory designer.

A method is presented for suppression of engine-exhaust noise by means of a low-pass acoustic filter, the design of which is based upon the harmonic analysis of the periodic engine-exhaust pressure variation. The Fourier frequency spectrum thus obtained for the pressure data exhibits excellent agreement with the experimental sound spectrum. The assumption of a simple source spherical radiator from the end of the exhaust pipe permits the calculation of the sound intensity. Thus a reasonably simple method is presented to predict accurately the frequency spectrum and the intensity of the noise emitted from the end of the exhaust pipe of any internal-combustion engine. The calculation of the cutoff frequencies and the expected degree of silencing as a function of frequency are presented for the various types of mufflers. An example for the harmonic analysis and suppression of the exhaust noise from a single cylinder, two-cycle gasoline engine is shown.

Simulation of a Reciprocating Compressor of an Electronic Analog Computer.....58—A-146

By Walter Brunner, Princeton Computation Center, Electronic Associates, Inc., Princeton, N. J. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Reciprocating compressors are employed to put energy into a system or process. This added energy in the form of a compressed gas may be used in chemical or petroleum industries; for instance, in pumping gas to a distillation column, or for long-distance transmission of natural gas. In most instances several compressors may work together in parallel and/or in series.

Although reciprocating compressors have been in existence for years due to the fact that a compressor with the associated piping represents a very complex system, the complete analytical solution of the pulsation problem has been impossible to attain without some serious simplifying assumptions. It has been only with the advent of computers that systematic studies of such systems have been carried out.

A system approach is employed in studying a reciprocating compressor system with its associated piping to maximize compressor efficiency and minimize pulsations. The differential equations describing the behavior of a reciprocating compressor are formulated from thermodynamic and kinematic considerations, and the system complete with nonlinearities is studied by means of an electronic analog computer. It is shown that the valve is an all important part of the total system and should not be neglected in a pulsation study from the point of view of over-all compressor efficiency.

Nuclear Engineering

Technical Design of the Dresden Nuclear Power Station..58—SA-73

B. L. E. Foster, General Electric Company, San Jose, Calif. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

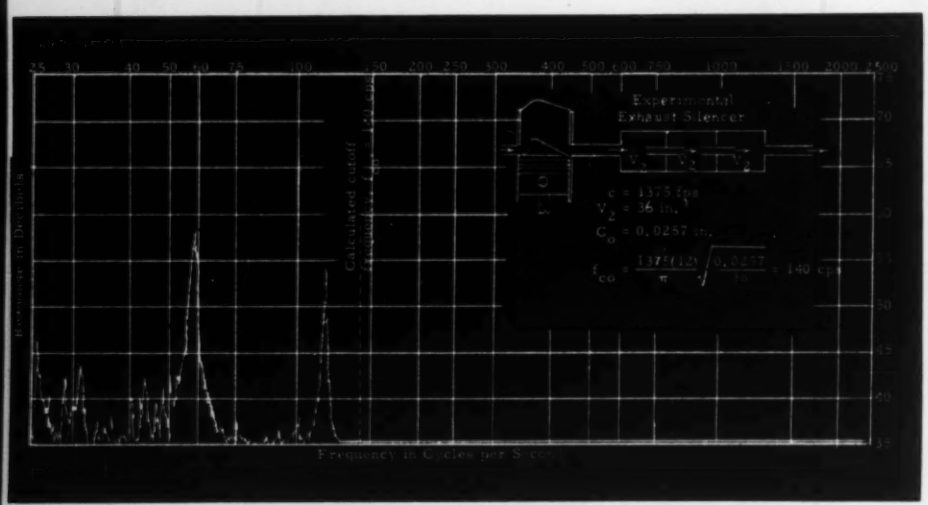
The design objectives of the Dresden Nuclear Power Station have not changed since 1956 when design of the station was approximately 25 per cent complete. These objectives are:

1 A station rated at 180,000-kw net electrical output.

2 An operationally safe and reliable station.

3 A station approaching the economics of a conventional plant.

A review description of the Dresden Nuclear Power Station is presented as an introduction to the main theme of the paper. A summary of some of the technical bases (resulting from calculated and test procedures) used for the reactor portion of this plant design forms the main body of the discussion. A concluding section on current design, procurement, and construction is given.



Experimental engine-exhaust noise data from a single-cylinder, two-cycle engine operating at 3600 rpm. Engine equipped with tubular-type, three-chambered, low-pass filter designed for a cutoff frequency of 140 cps. (58—A-144)

Instruments and Regulators

An Experiment in Control Engineering . . . . . 58—A-164

By J. H. Westcott, Imperial College of Science and Technology, London, England. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The exacting requirements for an adequate training of control engineers are placing an increasing strain on the existing departmental structure of engineering colleges. Suggestions have been made that this structure should be radically altered for the subject of control engineering. An alternative scheme described in the paper, which is being put into effect at the author's college, does not involve dismantling the existing structure but nevertheless represents an effective solution to this difficult problem.

In basic outline, the scheme involves founding a central nucleus of control experts under the aegis of an existing department. This group, while primarily concerned with research work of a fundamental kind, will also be responsible for organizing courses in control engineering for all engineering students. A two-year course of postgraduate study is being implemented.

In the advanced and more specialized part of the course, close collaboration occurs between the central group and specialists in all the contributory departments. Co-operation is further encouraged by the establishment of computing facilities by the central group as a service to all departments and by collaboration on research projects taking place in other departments that are concerned with control engineering. In this way an active group is established around which control-engineering activity throughout the college can be related and interconnected. The scope of this activity can be very wide by virtue of links made with the various departments, allowing full advantage to be taken of facilities and interest existing in the college as a whole.

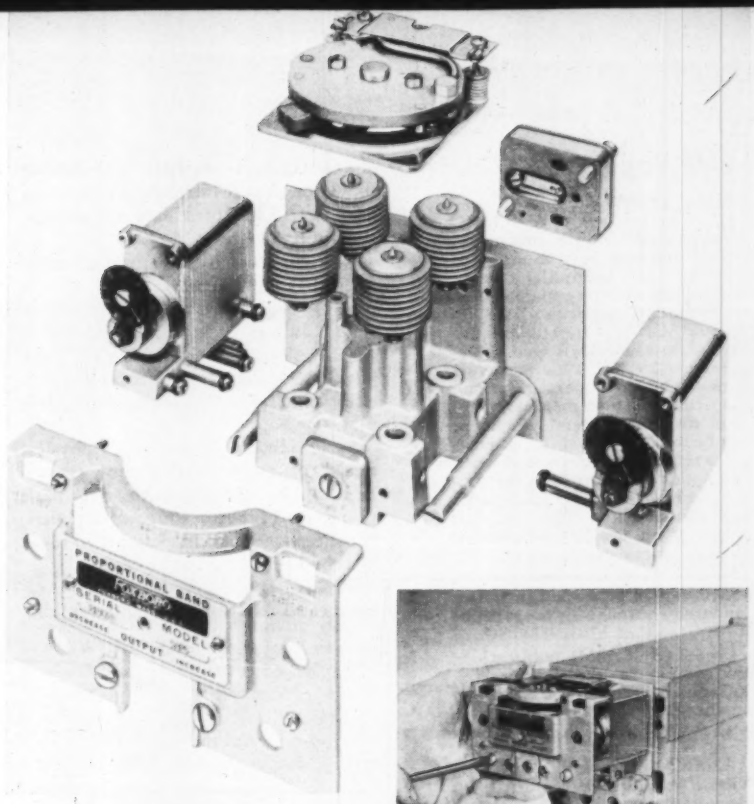
Analysis of a Pneumatic Force-Balance Controller. . . . . 58—A-203

By J. L. Pritchard, The Foxboro Company, Foxboro, Mass. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

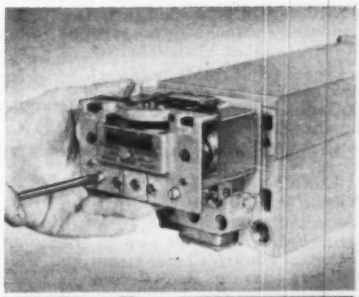
Historically, the development of automatic controllers for the process industry has been through a relatively empirical and pseudotheoretical procedure. The result of this approach has been the development of several mechanical and pneumatic devices that were amazingly close to designs which one might have expected from a more modern theoretical approach. This paper presents the theoretical study of a controller that was designed in the interim period, when a relatively unorganized combination of theory and practice was incorporated.

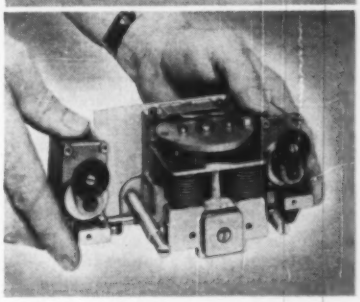
The controller has been very well accepted by users and this study was initiated to make it possible for future designers to benefit from the design features.

The dynamic characteristics of a three-function pneumatic force-balance controller is determined by computation and then compared with actual performance. Although the three functions are not "pure," it is shown that it is possible to describe the device and closely compute the performance analytically. This study does not purport to consider the nonlinear aspect of the controller, but attempts to do a rather thorough analysis on a small signal, nonsaturation basis with the idea that nonlinear studies could be made on analog equipment using the material in this paper as the point of departure.



Pneumatic force-balance controller, fully assembled, *right*, partially assembled, *bottom right*, and an exploded view shown *above* (58—A-203)





Educating Qualified Semiprofessional Specialists in Control Technology . . . . . 58—A-179

By L. E. Slater, Foundation for Instrumentation and Research, Inc., New York, N. Y. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Properly trained, the semiprofessional specialist in the field of control technology should be able to undertake the following functions:

1 Duplicate existing control systems with necessary minor modifications to adapt them to relatively new situations, in other words, do a good deal of the application engineering of the field.

2 Set up and perform the routine tests of data acquisition in dynamic studies of existing systems and new control systems; if necessary, reduce and analyze the subsequent data.

3 Operate the specialized "tools"

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of the control engineer; the analog simulator, data reduction and computing machines, high-speed data acquisition, and display devices.

4 Perform some of the routine mathematical and graphical tasks of the control engineer: The derivation of simple differential equations; the use of the inverse Laplace transformation; work with block diagrams; execute the Nyquist plot, Bode diagram, root locus plot.

5 Breadboard or mock-up a physical model of a specified control system; be familiar enough with the basic properties of power stages, amplifiers, and electromechanical elements to select and choose for a definite problem.

6 Design, construct, and test experimental electronic circuits or subsystems; often these circuits are required by the control engineer in the development of a new component or system.

7 Adjust and "tune-in" controllers in a system; familiarity with controller modes, process characteristics, and empirical methods of setting controllers is a necessity.

8 Be familiar enough with the operating principles of commercially available instruments and control devices to analyze difficulties and effect emergency repairs.

The problem of educating the semiprofessional control specialist is considered in this paper. Questions of diversity versus specialization, schools for semiprofessionals, and the particular problems of control education at the semiprofessional level are noted.

ASME TRANSACTIONS

THE November, 1958, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers), contains the following papers:

Temperature Distribution in Fins and Other Projects, Including Those of Building Structures, by Several Procedures, by C. F. Kayan and R. G. Gates. (57—A-177)

Aluminum in Rolling Stock; Impact Tests at Collision Speeds, by R. A. Campbell, J. G. Sutherland, J. F. Whiting, and R. A. Kemp. (58—RR-1)

Vibration and Shock in Freight Cars as Causes of Lading Damage, by J. C. Settles. (58—RR-4)

Analysis of the Steam-Turbine Reheat Cycle, by J. Kenneth Salisbury. (57—A-186)

Application of the Griffith-Irwin Theory of Crack Propagation to the Bursting Behavior of Disks, Including Analytical and Experimental Studies, by D. H. Winne and B. M. Wundt. (57—A-249)

Treatment of Make-up Feedwater, Condensate, and Recycle Water for Supercritical and Nuclear-Reactor Power-Plant Cycles, V. J. Calise and J. H. Duff. (57—A-198)

An Indirect Method for Determining Accelerations in Complex Mechanisms, by T. P. Goodman. (57—A-108)

Three-Dimensional Photoelasticity and Its Application in Machine Design, by M. M. Leven and A. M. Wahl. (57—A-87)

Dynamic Characteristics of Cam Forms Calculated by the Digital Computer, by S. Mercer, Jr., and A. R. Holowenko. (57—A-42)

On the Art of Designing Compressor Foundations, by W. F. Swiger. (57—A-67)

The Boundary Layer on the End-Wall of a Turbine Nozzle Cascade, by Yasutoshi Senoo. (57—A-172)

Three-Dimensional Laminar Boundary Layer in Curved Channel with Acceleration, by Yasutoshi Senoo. (57—A-173)

A Theory of Lubrication in Short Journal Bearings With Turbulent Flow, by L. N. Tao. (57—A-68)

The Performance and Reliability of Aero-Gas-Turbine Combustion Chambers, by J. S. Clarke and H. E. Lardge. (57—GTP-13)

Slipper Bearings and Vibration Control in Small Gas Turbines, by H. C. Hill. (58—GTP-6)

Rearrangement of the Temperature Field in Flow Around a Bend, by E. R. G. Eckert and T. F. Irvine, Jr. (58—GTP-2)

The Use of Adjustable-Stator Blades to Reduce the Idle Fuel of a Simple-Cycle, Single-Shaft Gas Turbine, by C. Howard, Jr., and R. L. Hendrickson. (58—GTP-5)

Present State and Future Outlook of the Free-Piston Engine, by R. Huber. (58—GTP-9)

Optimization of Plate-Type Air Preheaters for Automotive Gas Turbines, by W. Hryniszak

Subharmonic Oscillations of Nonlinear Feedback Control Systems, by Katsuhiko Ogata. (58—IRD-7)

Dynamic Analysis of a Boiler, by K. L. Chien, E. I. Ergin, C. Ling, and Allyn Lee. (58—IRD-4)

Optimal Synthesis of Linear Sampling Control Systems Using Generalized Performance Indexes, by R. E. Kalman and R. W. Koepcke. (58—IRD-6)

Time Domain Synthesis of Sampled-Data Control Systems, by E. I. Jury and F. W. Semelka. (58—IRD-8)

Continuous Measurement of Characteristics of Systems With Random Inputs: A Step Toward Self-Optimizing Control, by T. P. Goodman and R. H. Hillsley. (58—IRD-5)

Gyro-Integrating Mass Flowmeter, by L. T. Akeley, L. A. Batchelder, and D. S. Cleveland, (58—IRD-3)

Includes Letters from Readers on Miscellaneous Subjects

COMMENTS ON PAPERS

Design Considerations for AWHEM 15,000-Psi Flanges

Comment by M. J. Epperson[1]

THIS paper[2] on the design considerations for AWHEM flanges is complete and interesting.

The basic concepts used in the design of this connection are considered satisfactory from the user standpoint. Increasing the minimum yield strength of the material from 60,000 psi to 75,000 psi is in line with increases made in the strength of tubular goods used in the deeper and higher pressure wells. The design factor of two based on minimum yield strength and working pressure should provide an adequate margin of safety. The use of the gasket as a seal only and not as a load-carrying member is particularly important where the connection is subjected to vibration such as that occurring during drilling operations. With the now standard API connections, it is necessary to retighten the bolts periodically to maintain a seal at the connections between and below the blowout preventers. A number of wells have gotten out of control as the result of leakage at these connections. With the AWHEM design, there should be no tendency for the connections to loosen due to vibration since the loads would be transmitted to the flange faces instead of to the relatively soft gasket.

Tidewater installed what is thought to be the first wellhead equipment with the AWHEM connections on its Homer Thibodeaux No. 1 Well in Acadia Parish, La. This well was completed on April 8, 1957, with a shut-in surface pressure of 10,080 psi. The well was completed with concentric tubing strings, $2^{3}/_{8}$-in. tubing inside $4^{1}/_{2}$-in. tubing, which required the use of two tubing heads. The AWHEM design was used for all connections above the spool in which the 7-in. casing was suspended. Indicator studs were used on all AWHEM connections to insure uniform and proper tightening. No difficulty was experienced in making up the connections in the field.

Each connection was hydrostatically tested to 15,000 psi. No leakage was observed during these tests and no leakage has occurred since the well has been on production.

One factor that perhaps should be mentioned is the importance of careful handling of the gaskets in the field. As compared to most oil-field equipment, the AWHEM gasket is relatively susceptible to damage, as any other high-pressure gasket would be, and careful handling by field personnel is essential. Due to the limited make-up of the AWHEM connections, minor nicks or scratches across the sealing surfaces could possibly result in leakage. Although field handling is primarily a user problem, it is possible that some consideration should be given to the packaging of spare or loose gaskets in such a manner as to emphasize the importance of careful handling in shipment and in the field.

The development of the AWHEM connection design is considered to be an important step in solving the problem of safely containing the increasingly higher wellhead pressures now being encountered. Early standardization of this design for 15,000 psi working-pressure equipment should result in substantial savings to both manufacturers and users.

The association of Well Head Equipment Manufacturers and the many companies and individuals who have worked through the Association on the development and testing of the AWHEM connection are to be commended for a major contribution to the oil industry.

[1] Division mechanical engineer, Tidewater Oil Company, Houston, Texas.

[2] Robert Eichenberg, "Design Considerations for AWHEM 15,000-Psi Flanges," MECHANICAL ENGINEERING, March, 1958, vol. 80, pp. 66–68, condensed from ASME Paper No. 57—Pet-23.

Comment by F. S. G. Williams[3]

The author of this paper[2] and the members of the association that co-operated in the work that is reported are to be commended.

The problem of containing very high pressures quite properly requires an engineering approach that will limit some of the factors and eliminate the necessity for progressively increasing the contingencies that must be built into the design criteria. The author mentions the present Code concept which calls for a residual pressure on the gasket to be expressed in terms of a multiple of the operating design pressure. The use of metallic gaskets and details of design which provide restraint from blowout warrant a limiting assumption on very high pressure work different than that used in moderate pressure service. It has been the writer's feeling for some time that this factor could more properly be expressed in terms of a multiple of the working pressure but not to exceed some figure which is related to the material properties of the gasket and flange materials. Unfortunately the Code Committees have not had sufficient data available to them to intelligently set these upper limits. Users and designers should make any knowledge or experience they have in this field available for evaluation.

The author reflects that their investigations did not disclose any great significance to variations in the flank angle of the ring joint groove. This is surprising in view of the investigative work done many years ago when the conventional ring joint proportions were developed. It has always been the writer's understanding that the previous investigative work showed that the angle was an important criteria, and that the 23-deg angle currently in use reflected the previous investigative work. More information on this subject would be helpful.

[3] Engineering consultant, Taylor Forge & Pipe Works, Chicago, Ill. Mem. ASME.

Comment by O. L. Nordin[4] and J. E. Loeffler[5]

The author presents a concise and accurate summary of the work of the AWHEM Standardization Committee. His paper[2] should be a valuable reference for other designers. Every effort that tends to clarify the confusion existent in the oil industry on flange design, and leads to adoption and publication of a method of design should be welcome, especially as a means of extending the 10,000 psi API flange family to larger sizes.

Any new design procedure should provide a more accurate knowledge of the safety factor and reduce the possibility of leakage of the joint. It appears that the procedure offered here has resulted in greater economy and safety of large high-pressure joints for the oil industry.

The seal is of particular interest, being the heart of the design. The octagonal metal ring, heretofore dealt with rather arbitrarily, is here considered in a truer manner as to the design loads involved. Such knowledge is much needed as working pressures approach the strength of materials available. Considering the user's desire for face-to-face construction, this design procedure comes about as close as is practical to an ideal sealing system. Some compromises were made as is always necessary, but the committee chose wisely in selecting the octagonal metal seal.

It is stated that the flank angle of the seal is of no great importance. True, much significance of the flank angle is lost when the ring is totally trapped, but the gasket-load component which the bolts must carry is a function of the flank angle. With a 23-deg angle the axial component is about 25 per cent of the pressure load. This is less gasket load than previous designs but a smaller angle would reduce it more.

A full floating seal, with flange faces separated somewhat, would further reduce axial load. Here a narrow flank angle is essential for self-sealing and flexibility as the floating seal requires a low ratio of radial-to-axial movement as the joint is pressured. Too large an angle will result in the ring going from compression into tension as the joint separates slightly under pressure, with a resultant loss of seal.

Admittedly the close tolerances required to prevent overstressing the ring on pulling the flanges face to face cannot be held in the AWHEM joint, and permanent set of the ring is a foregone conclusion. Thus compression will be much less upon re-use of the ring necessitating extreme care in handling rings intended for re-use.

The design formulas consider the pressure loading which establishes the self-energizing forces to apply these forces to both the inner and outer seats. Such is not actually the case. The self-sealing forces can be applied only to the outer seat. If this concept were considered in the design, a reduction of the seating load from 18 per cent of the pressure load down to 9 per cent of the pressure load could be realized.

[4] Mechanical Engineer and [5] Chief Mechanical Engineer, Thornhill-Craver Company, Inc., Houston, Texas. Both are Mem. ASME.

Airsprings Cushion the Ride

Comment by J. I. Weindling[6]

The author has written the most comprehensive and informative paper[7] on the subject of the airspring I have seen. There has been a lot of general discussion on the subject, but little has appeared that would be of actual help to the designer, and, perhaps, even more technical data than were presented would have been of still greater service.

During investigation of the possibilities of using airsprings for industrial vibration control, several serious, though by no means insurmountable, limitations of the airspring came to light. For example, the author's statement that there is no difference between the dynamic and static stiffness of the airspring is true only in comparing high-frequency response to relatively slow dynamic response, where a great difference in these two factors does exist for solid elastomers and other organic materials. However, when by static load is meant an actual load which will be in place for several minutes, hours, or days, the pressure volume relationship $PV^n = C$, which is the most important factor in determining the airspring stiffness, has a value of $n = k$ (ratio of specific heats at constant pressure and constant volume) for dynamic response, while when reaching ambient temperature $N = 1$, giving a softer action and greater deflection or movement due to the static load than to the dynamic. This dependence of the volume upon the temperature also creates a problem in making a self-contained mounting since, if a mounting is raised with the machine mounted on it to a given height, when there is a substantial temperature change there can be a fair amount of raising or lowering of the equipment which would inflict severe stresses on any piping or other connections to the equipment. Since the airspring is economical primarily where extremely low frequencies are desirable, the reservoirs that might be used to achieve these low frequencies would aggravate this condition since the total volume loss due to a temperature drop might actually be of an order equal in magnitude to the volume of the diaphragm itself. Of course, these problems exist primarily with self-contained units, since the outside air supply available either from a line compressor or from a master supply tank could be used where the size of the installation or other factors permit the additional cost—this is the case with the automobile.

Lateral stiffness and long life are mentioned as advantages of the airspring. It is my understanding that a system of control rods is required to compensate for the lack of such lateral stiffness in automobiles, and tests under a machine tool indicated that the lateral resistance of the airspring was so low as to give excessive movement unless external control means were used. The life of the airspring is no doubt adequate for the first user life of an automobile, which is probably less than five years, but for industrial installations, where lives of upwards of ten years are expected, the bellows or diaphragm at least of the unit might have to be replaced during the life of the equipment.

Among the advantages of the airspring stated by the author, the most attractive ones from the standpoint of industrial application are the fact that the air itself can be used to raise and level the machine (although the automotive-type of leveling valve has far too great an inactive arc to be suitable for those industrial equipments requiring accurate leveling), the very low natural frequencies attainable with certain types of the airspring when using a reservoir, and the wide effective load range without a change of natural frequency attainable which means that the often tedious and difficult task of determining the exact weight distribution can be substantially simplified. None of these are unattainable with steel springs, since steel-spring vibration isolators are available with built-in leveling features, suspension springs could give extremely large effective static deflections with very low natural frequencies, and conical springs can be designed to give constant frequencies over very wide load ranges. It's just that the airspring has the potential of doing these things so much more simply.

The change in effective area in the

[6] Chief engineer, The Korfund Company, Inc., Long Island City, N. Y. Mem. ASME.

[7] H. H. Deist, "Airsprings Cushion the Ride," Mechanical Engineering, June, 1958, vol. 80, pp. 61–63, condensed from ASME Paper No. 57—A-179.

standard convolution bellows-type of airspring is due essentially to the diaphragm stiffness; indeed, it is this stiffness which is the limiting factor in the use of this airspring at very light loads and with large reservoir volumes. For the single convolution, unequal bead diameter airspring, it is primarily the fact that the effective area can be controlled by means of the pedestal shape that permits using a small reservoir, rather than the fact that a long stroke is available. The length of stroke merely determines the maximum amplitude, but does not determine the natural frequencies—it is this factor which makes the airspring so convenient for extremely low frequencies, permitting a relatively small mounting to give large effective deflections, while for a steel spring, neglecting the effect of initial tension in suspension springs, large springs would be required to give large deflections and these springs would be required to have long strokes.

Under nomenclature, the symbol L seems to be used for both static and dynamic load, rather than just for dynamic load as defined, the symbol identified as the polytropic coefficient is actually used as the isentropic coefficient, and the term V_0, although not defined, appears to be used as the volume at the extended position.

Under relationship equations, equation 3 actually applies only to the type of airspring in which the flexing portion of the bellows is contained between two constant area cylinders, such as in the Ford airspring, but which was not illustrated anywhere in the paper. Equation 4, which I assume has been found to be the form which will best fit the empirical data on effective area, is especially interesting; I have used a power series myself fitted by the method of least squares, and have found satisfactory agreement by going to a third degree series, but it is possible that the exponential form given might fit the empirical data more accurately.

Once the equations have been determined, the natural frequency can be obtained rather readily by analytic means, without resorting to graphical means. The equivalent static deflection is equal to L/K, where $K = dL/dx$.

That nonlinearity of the spring will prevent any resonance effects is a common oversimplification. Although resonance in the simple sense used for linear systems cannot be defined for the nonlinear spring, there is a possible build-up of amplitude, although the actual value of this amplitude achieved will depend upon whether the particular frequency of steady-state vibration is achieved by an increase of the frequency from zero or by a reduction of the frequency from some higher value.

Author's Closure

Several of Mr. Weindling's comments lead to areas beyond the scope of the paper[7] which was intended to be general in nature in order to cover all phases of the subject. I would, however, like to clarify several of the questions raised.

1 It was not intended to imply that there is no difference between dynamic and static stiffness of an airspring. This is certainly not true. Rather it was intended to point out that air is the load-carrying medium, not rubber. The dynamic properties of the small amount of rubber used have little influence on the over-all performance of the airspring.

2 For convolution-type airsprings with the ends restrained, the lateral rate is much greater than the axial rate.

3 Life of airsprings in industrial applications has been no problem. At Firestone we have many installations that have been in daily use for ten years with no signs of failure.

4 Effective area may be controlled by external restraining means or by pedestal shape or by both. When no external restraining means are used, the effective area is influenced by the length of the cord fabric used, which in turn is determined by the length of the stroke required.

5 The relationship equations given are typical for the types of airsprings described in the paper.

H. H. Deist.[8]

[8] Engineer, The Firestone Tire & Rubber Company, Akron, Ohio. Mem ASME.

Progressive Mechanization

Comment by G. R. Fitzgerald[9]

The author of this paper[10] has presented an interesting study of the economics of mechanization. In their enthusiasm to get on the "mechanization bandwagon" undoubtedly many manufacturers have not estimated costs too wisely, but have assumed that because a process was automatic it must offer the greatest savings potential. True, the indirect costs of operating new mechanized equipment at times are most difficult to estimate and thus convenient to ignore. However, one must agree with the author that if the main reason for mechanization is economic, as it usually is, complete and careful analysis of all cost factors in the manner suggested are definitely in order.

At the same time, it must be mentioned that situations may occur where mechanization might be justified despite the fact that the economic climate would not be favorable. Some possible examples are

1 To improve product quality.

2 To reduce worker effort, fatigue, and so on.

3 To permit handling of hazardous materials.

4 To provide an opportunity for an organization to obtain experience with mechanization in a situation that a group lacking in such experience can adequately handle. Or, expressed in another way, a mechanization program may be initiated on a relatively simple piece of special automatic equipment for training purposes, even though the economics may not be entirely favorable. The group can then proceed with confidence born of experience to the more difficult situations that offer greater savings potential.

Perhaps there are other situations than these which may dictate mechanization in an unfavorable economic climate. However, in none of these is there any justification for a failure to measure all costs of all methods before proceeding. Even though other factors may be of greater importance in a given situation, complete and adequate cost data should be developed so that whatever the decision, it can be made with all of the facts available.

[9] Director of engineering and equipment sales, AC Spark Plug Division, General Motors Corporation, Flint, Mich.

[10] A. J. Dunkle, "Progressive Mechanization," Mechanical Engineering, June, 1958, vol. 80, pp. 76–77, condensed from ASME Paper No. 57—A-215.

Engineering Research With a Solar Furnace

Comment by Tibor S. Laszlo[11]

The design principles of solar furnaces have been explored to a great extent and we know by now how to build one with the best possible performance. Far less work was done to develop methods and instruments for experimentation in the solar furnace. Conventional instruments cannot be used partly because of the high-radiant energy fluxes, and partly because of the unusual spatial arrangement of the furnace. The author's work[12] on measuring instruments specially developed for solar furnaces is therefore of great interest and importance.

[11] Senior staff scientist, AVCO Research and Advanced Development Division, Wilmington, Mass.

[12] P. E. Glaser, "Engineering Research With a Solar Furnace," Mechanical Engineering, vol. 80, pp. 78–80, condensed from ASME Paper No. 57—A-261.

One of the most important problems encountered in all high-temperature operation is the measurement of temperature. The author suggests the use of a dual color pyrometer for temperature measurement which would eliminate the need to know the emissivity. It is interesting to note that a paper on the theory of the method suggests the use of two wide, overlapping wave bands. The dual color pyrometer is based on the assumption that emissivity does not vary much with the change of wave length. It has been shown, however, that this assumption is not fully justified and dual color pyrometry may cause over 20 per cent error in temperature readings above 2000 K. Accordingly the problem of emissivity measurement has to be faced and solved whenever an optical pyrometer is used above 2000 K not under black-body conditions.

The solar furnace offers a solution to the measurement of emissivity at high temperatures. The heat flux in the focal zone of any one solar furnace is dependent only on the intensity of the normal incident solar radiation. Once this is available the emissivity of any sample can be measured in the following way: The brightness temperature of the target is measured with an optical pyrometer and simultaneously the normal incident solar radiation is recorded with a pyrheliometer. From the latter data the heat flux can be calculated and this value substituted into the Stefan-Boltzmann equation:

$$E = \sigma T^4 \qquad (1)$$

The temperature calculated from (1) is the black-body temperature, i.e., the temperature the sample would have if its emissivity were unity. From the measured brightness temperature and the calculated black-body temperature the emissivity of the sample can be calculated.

This will be the true emissivity of the sample at the experimental temperature, for the wave length of the optical pyrometer used and for the existing surface conditions of the sample.

Author's Closure

Dr. Laszlo's concern over the importance of the temperature measurement problem in a solar furnace is fully shared by me. Since the start of our high-temperature research work, we have sought for the most direct method for measuring the temperature of unenclosed objects of unknown emissivity. The two-color pyrometer referred to was one of the methods we have investigated. Its theory and limitations together with other temperature measuring instruments considered during the course of our work have been fully discussed elsewhere.[13]

We are now using a modified optical pyrometer in conjunction with a system of shutters for separating incident and reflected radiation to measure temperatures in the solar furnace. This pyrometer requires a reasonably accurate knowledge of the spectral emissivity at 0.65 micron which is determined from measurement of the reflected radiation and from the Kirchoff's equation relating reflectivity to emissivity.

The method suggested by Dr. Laszlo for measuring emissivity does not take into account the theoretical nature of the heat flux calculated from the normal incident solar radiation as recorded with the pyrheliometer. The actual heat flux reaching the sample will be dependent on the geometrical perfection and reflectivity of the paraboloidal concentrating mirror and cannot be easily evaluated because the measurement of geometrical perfection is a lengthy procedure and the mirror reflectivity may change with time due to oxidation and dirt deposition. Hence the actual heat flux reaching the sample will be lower and will not be equal to the theoretical heat flux and the corresponding calculated black-body temperature. In addition, the temperature reached by the sample will be lower than the temperature deduced from the calculated black-body temperature due to conduction losses. Depending on the nature of the sample, these losses could become appreciable; and their magnitude would be difficult to estimate.

Peter E. Glaser.[14]

Selecting Flight-Test Instrumentation

Comment by D. A. Drew[15]

In regard to the author's statement[16] that airborne tape systems have no advantages over oscillographic recording relative to size and accuracy, this writer would point out that Rolls-Royce has had several years' experience of flying multichannel recorders and has found that the bulk and weight of the records made on magnetic tape were a very great deal less than the bulk and weight of photographic recordings. In round numbers, it is not found practical to analyze on photographic material more than 50 cycles per in., giving a wavelength of 0.020 in., whereas it is perfectly possible to work with a wavelength on magnetic tape of 0.0005 in., i.e., to record 2 kc per sec for a tape speed of one in. per sec. This gives a size advantage in length of tape over paper of 40:1.

Assuming that to get a reasonable accuracy on paper four inches are required for eight channels, there is a further advantage of 4:1 on using inch-wide tape for eight channels, which is the Rolls-Royce practice, although in the U. S. A., 14 channels per in. are often used.

The thickness and weight of magnetic tape are almost half that of paper.

This gives an over-all bulk advantage of magnetic tape of $40 \times 4 \times 2 = 320$ for direct recording. If an FM system is used for accuracy, then the bulk advantage is reduced to the order of 32:1.

The afore-mentioned figures were given by the writer from memory during the meeting but on returning to England he has checked up the relative thicknesses of photographic and magnetic recording materials and finds that the ratio is more nearly 4:1 than 2:1. This gives a total bulk and weight advantage to the magnetic recording material of 640 or 64 for direct and FM recording systems.

Author's Closure

The comments of Mr. Drew regarding the relative data capacity of recording materials, appear to be substantially correct. However, the author did not have reference to the recording materials alone but to the over-all airborne tape system.

To further illustrate the comparison of oscillograph and airborne tape systems on the basis of size and weight, the following information relates to commercially available equipment. The 14-channel Ampex airborne FM tape system, provided with carrier-type preamplifiers, has a size of 5.5 cu ft, weight of 240 lb, and a power requirement of 1300 watts. This compares unfavorably with a 36-channel Consolidated flight-type oscillograph, with necessary control boxes, which has a volume of 2.7 cu ft, weighs 110 lb, and requires 500 watts of power. The pickups were not included as it was assumed that both systems would be fed from the same strain-gage-type sensors.

C. H. Nelson.[17]

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[13] Emslie, A. G., and H. H. Blau, Jr., "On the Measurement of Temperature of Unenclosed Objects by Radiation Methods," to be published in the Journal of the Electro-Chemical Society. (Preprints obtainable from the authors.)

[14] Senior research engineer, Arthur D. Little, Inc., Cambridge, Mass. Assoc. Mem. ASME.

[15] Vibration department, Rolls-Royce Limited Aero Engine Division, Derby, England.

[16] C. H. Nelson, "Selecting Flight Test Instrumentation," MECHANICAL ENGINEERING, vol. 80, July, 1958, pp. 52–55, condensed from ASME Paper No. 57—A-225.

[17] NASA, Langley Research Center, Langley Field, Va.

BOOKS RECEIVED IN LIBRARY

Brennbare Industriestaube
(VDI Berichte, vol. 19.) 1957, Verein Deutscher Ingenieure, Düsseldorf, Germany. 104 p., 8¼ × 11¾ in., paper. DM 19.80. The 13 papers in this compilation cover various aspects of research on combustible industrial dusts, for example: Electrostatic charges and the ignition of dust; dust characteristics; the combustion process in dusts; calculation of ignition values and maximum explosion pressures; explosibility of various types of dusts; special research activities in connection with dust fires and explosions.

Data Book for Civil Engineers
Vol. 2: Specifications and Costs. By Elwyn E. Seelye. Third Edition. 1957, John Wiley & Sons, Inc., New York, N. Y. Various pagings, 9½ × 12 in., bound. $20. Vol. 2 of this three-volume set provides data necessary for preparing specifications for buildings, airports, roads, railroads, bridges, dams, docks, drainage, and sewers. Swimming pools, athletic fields, and other miscellaneous structures are briefly considered. Relative cost analyses are included for each type of work, and there is a classified glossary of terms. In addition to the extensive amount of practical data presented in this book, the other two volumes of the set provide similarly useful information on design and field practice.

Der Industrielle Wärmeübergang
By Alfred Schack. Fifth Edition, 1957. Verlag Stahleisen, Düsseldorf, Germany. 434 p., 6¼ × 9¼ in., bound. DM 43.75. This new edition of a standard German treatise on the theory and practice of heat transfer provides the practicing engineer with the necessary fundamental technical information available as of 1956. The data presented are drawn from English and American sources as well as German. New material in this edition includes such topics as heat-transfer values for boiling metals and heat transfer on a take-off run of an airplane.

Design of Machines
By R. T. Hinkle. 1957, Prentice-Hall, Inc., Englewood Cliffs, N. J. 188 p., 6¼ × 9½ in., bound. $4. A clear and concise presentation of basic theory and of practical methods for the design of centrifugal coupling, thrust or brakes, gear reducers, a 30-ton yoke riveter, and a manual lift truck. The book is primarily for use in a second course in machine design.

Documentation and Information Retrieval
By J. W. Perry and Allen Kent. 1957, Western Reserve University, Cleveland, Ohio; Interscience Publishers, New York, N. Y. 156 p., 5¾ × 8¾ in., bound. $5. Based on research in progress at the School of Library Science at Western Reserve University, this book was written with the conviction that mathematical formulation of basic principles together with cost analysis of procedures and operations will permit the development of information systems to be placed on a firm engineering basis.

Effect of Residual Elements on the Properties of Metals
By Earl R. Parker and others. 1957, American Society for Metals, Cleveland, Ohio. 217 p., 6 × 9¼ in., bound. $4. The five papers in this book describe the effects of various factors on the structure sensitive properties of metals. The first paper entitled "Fundamental Considerations" discusses the effects of lattice imperfections, solute atoms, and the presence of a second phase. The remaining papers deal with impurities and residual elements in common nonferrous metals, steels, semiconductors, and the so-called newer metals—titanium, zirconium, molybdenum, and chromium.

Elementary Thermodynamics
By Virgil M. Faires. Third Edition. 1957, The Macmillan Co., New York, N. Y. 379 p., 6¼ × 9½ in., bound. $6.75. Topics of importance for short courses in thermodynamics are covered, including energy equations, reversible nonflow gas processes, thermodynamic cycles, compression and expansion of gases, the gas turbine, vapors and vapor cycles, refrigeration, nozzle flow, and the properties of mixtures. The revision in this edition involves some reorganization of the material to provide a more logical approach for effective understanding.

Engineering Properties and Applications of Plastics
By Gilbert F. Kinney. 1957, John Wiley & Sons, Inc., New York, N. Y. 278 p., 6¼ × 9¼ in., bound. $6.75. The various plastics are described separately and more or less in the order of increasing complexity. A unified treatment, emphasizing the fundamental nature of plastics, permits the principles, concepts, and terminology to be established in the simpler cases, and is utilized in treatment of the more complex materials. Separate chapters describe methods for fabrication, and the mechanical, electrical, optical, and thermal properties of those materials.

Fundamentals of Mechanical Design
By Richard M. Phelan. 1957, McGraw-Hill Book Co., Inc., New York, N. Y. 526 p., 6 × 9¼ in., bound. $8.75. This text is an integrated treatment of kinematics, mechanism, dynamics of machinery, and design of machine elements, presenting in one volume the essentials of the sequence of courses usually offered to mechanical-engineering students. It is intended primarily as a textbook for electrical, mining, and other engineering students not specializing in mechanical engineering, but it may also be used as a refresher for engineers not in close contact with the field of mechanical design.

Guided Weapons
By Eric Burgess. 1957, The Macmillan Co., New York, N. Y. 255 p., 5½ × 8½ in., bound. $5. This is a general introduction to the subject, of interest to engineers entering the field of guided missile design as well as to the layman who wants to learn the fundamentals, historical and technical, on which guided weapons are based. In addition to dealing with technical features such as the power plant, the propellant, and guidance systems, the book discusses the wartime development of missiles and some of the problems of producing reliable weapons for defense.

Industrial Deafness
By Joseph Sataloff. 1957, McGraw-Hill Book Co., Inc., New York, N. Y. 333 p., 6¼ × 9¼ in., bound. $8. Industrial and safety engineers will be particularly interested in the second part of this volume, which deals with the principles and practice of noise measurement, determining the maximum safe intensity level, principles of noise abatement, and audiometric test rooms. The necessary background information on acoustics, sound, and deafness are presented in the first part, while the last part of the volume is a manual for industrial hearing testers. The book is intended for those with no previous experience in acoustics or hearing testing.

Le Mécanisme de la Coupe des Métaux
Publication Scientifique et Technique du Ministère de L'Air, No. 326, 1957, Service de Documentation et d'Information Technique, Paris, France. 98 p., 7½ × 10½ in., bound. 1600 fr. A re-examination of the mechanism of metal cutting, which briefly reviews previous theories and continues with the presentation and discussion of the results of subsequent experimental work. These results, covering the action of high-speed steel and carbide tools on brass and on carbon steels, are presented both in graphical and tabular form. Separate chapters are devoted to the measurement of forces and chip thickness, to the heat developed in the tool and the chip, and to tool vibration.

Nuclear Engineering
Edited by Charles F. Bonilla. 1957, McGraw-Hill Book Co., Inc., New York, N. Y. 850 p., 6½ × 9½ in., bound. $12.50. This graduate-level text, prepared by a group of 12 experts, presents fundamentals in concise handbook style and discusses more advanced aspects of the subject in detail. Comprehensive bibliographies are included. Chapters of particular interest are those on flow of fluids, thermal-stress analysis and mechanical design, and one on the legal aspects of nuclear power.

Petroleum and its Products
By J. H. Van Der Have and C. G. Verver. 1957, Pitman Publishing Corp., New York, N. Y. 421 p., 5¾ × 8¾ in., bound. $10. This is a concise summary of the whole field of petroleum production, covering exploration and drilling, crude oil composition and refining, and the manufacture, properties, and applications of petroleum derivatives. A list of basic references and important petroleum periodicals is appended.

Petroleum Cargoes: Measuring and Sampling
By H. Hyams. 1957, Brown, Son, & Ferguson, Ltd., Glasgow, Scotland. 379 p., 7½ × 9½ in., bound. 50s. A highly practical treatment of the problem of determining the quantity of petroleum products, from crude oil to high-octane gasoline, contained in oil tankers or barges. The explanatory material and the extensive group of tables cover not only bulk measurements and conversions, but also specific gravity determinations, volume correction coefficients for temperature, and other necessary or useful information. Petrochemicals and coal tar products are similarly treated in appendixes.

Physics for Science and Engineering
By R. L. Weber, M. W. White, and K. V. Manning. 1957, McGraw-Hill Book Co., Inc., New York, N. Y. 618 p., 7½ × 10¼ in., bound. $8. In providing a text designed specifically for the technical student, the authors have restricted the treatment to a practical explanation of the basic principles of mechanics, heat, sound, light, electricity, and magnetism. The application of these principles is effectively demonstrated by the accompanying problems. A brief section is devoted to nuclear physics, including a cut-away representation of a nuclear power plant.

Structural Design in Metals
By C. D. Williams and E. C. Harris. Second Edition. 1957, Ronald Press Co., New York, N. Y. 655 p., 6½ × 9½ in., bound. $8. The new edition of this text for a first course in design emphasizes basic training in the application of the statics of simple structures

and the strength of materials to details of design. In the revision, additions have been made to chapters on rigid frame design and design with light-gage metal, and recognition has been given to the use of other metals besides steel.

The Science of Engineering Materials
Edited by J. E. Goldman. 1957, John Wiley & Sons, Inc., New York, N. Y. 528 p., 5³/₄ × 9¼ in., bound. $12. Based on a series of lectures at Carnegie Institute of Technology in 1954 on the impact of solid-state science on engineering education, this book serves as a broad outline of this science which makes possible the development of improved and new engineering materials for specific engineering applications. The transistor is cited as an example of such development. The six sections in the book are: the structure of matter; metals and alloys; surfaces, magnetism and magnetic properties; semi-conductors and dielectrics; and noncrystalline materials.

Thermodynamik des Sprödbruches und ihre Anwendung im Stahlbau
Berichte des Deutschen Ausschusses für Stahlbau, Heft 20. By W. Kuntze. 1957, Stahlbau-Verlag, Köln, Germany. 104 p., 8 × 11 in., paper. DM 22.50. A comprehensive treatment of the thermodynamics of brittle fracture and its application to steel construction. The relation between theory and testing is discussed together with the technical results. Much of the information is presented in graphic or tabular form, and a detailed description is appended of the notched-bar tensile and impact testing methods.

ASME Handbook: Metals Engineering—Processes
Edited by Roger W. Bolz. 1958, McGraw-Hill Book Co., New York, N. Y. 428 p., 7½ × 10¼ in., bound. $13.50. Gives information on the various processes by which metals are converted into the finished product. Among the manufacturing methods included are the heat treatment of steel, casting, hot working, cold working, powder metallurgy, welding and cutting, machining, finishing, and electroforming. For each method the basic physical characteristics to be considered are given along with its advantages and disadvantages. Also presented are data on the suitability of various metals for each process and the tolerances on size and surface finish obtainable. One of a series of four volumes sponsored by The American Society of Mechanical Engineers.

The Administrative Process
By Robert H. Roy. 1958, The Johns Hopkins Press, Homewood, Baltimore, Maryland. 236 p., 6¼ × 9¼ in., bound. $5. Designed to be of practical help for management in solving administrative problems, this book deals with organization, channels of communication, delegation of authority, operations, analysis, forecasting and planning, resolution of conflict morale, and criteria for decisions. Written in an informal style with liberal use of examples and anecdotes.

Analytical Mechanics for Engineers
By Fred B. Seely and others. Fifth Edition. 1958, John Wiley & Sons, Inc., New York, N. Y. 475 p., 5³/₄ × 8³/₄ in., bound. $7.25. A standard text on the subject, covering statics, kinematics, kinetics, and various special topics. This edition includes new material on vector analysis; the equilibrium of bodies, making use of the concepts of virtual work; the equilibrium of force systems, utilizing a general coplanar force system; and the use of the inertia-force method in kinetics.

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ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

Annual Report on the Progress of Rubber Technology
Vol. XXI, 1957. Edited by T. J. Drakeley. 1957, W. Heffer & Sons Ltd., Cambridge, England, for the Institution of the Rubber Industry. 134 p., 7¼ × 10 in., bound. £1.5s. A series of papers surveying developments within the field of rubber technology, including compounding ingredients, fibers and fabrics, tires, belting, hose and tubing, cable and electrical insulation, footwear, surgical goods, cellular and hard rubber, flooring, machinery and appliances, and roads.

Applied Mathematics for Engineers and Physicists
By Louis A. Pipes. Second Edition. 1958, McGraw-Hill Book Co., New York, N. Y. 723 p., 6¼ × 9¼ in., bound. $8.75. Covers a wide range of topics in advanced fields of calculus. The chapters on matrix algebra, Fourier methods, variational methods, Laplace transforms, and nonlinear differential equations have been considerably expanded in this edition. A new section on Cartesian tensors has been added to the chapter on vector analysis. New illustrations have been added, and the number of problems doubled.

Bibliographic Survey of Corrosion, 1954–1955
Published by the National Association of Corrosion Engineers, Houston, Texas. 468 p., 8³/₄ × 11¼ in., bound. $20. A thorough review of corrosion literature for the period covered. Substantial abstracts of papers cited are arranged in eight major divisions: general, testing, characteristic corrosion phenomena, corrosive environments, preventive measures, materials of construction, equipment, and industries. Author and subject indexes are included.

Car Builders' Cyclopedia of American Practice
Twentieth Edition. 1957, Simmons-Boardman Publishing Corp., New York, N. Y. 1114 p., 8³/₄ × 11³/₄ in., bound. $15. A standard reference work providing definitions and illustrations of railroad and industrial cars along with their parts and equipment. In addition descriptions and illustrations of shops and equipment employed in the construction and repair of cars is given. This edition contains many new designs of cars and appliances.

Corrosion, A Symposium
Published 1956 by the Committee of the Symposium on Corrosion, University of Melbourne, Carlton N.3, Melbourne, Australia. 609 p., 5³/₄ × 8³/₄ in., bound. £2.10s. Thirty papers from a symposium held at the University of Melbourne in 1955. Papers in the first section deal with the fundamentals of corrosion and its prevention. The concluding section of the symposium deals with corrosion problems in various industries including the aircraft, chemical, gas, paper, petroleum, and power industries.

The Economics of Industrial Management
By Walter Rautenstrauch and Raymond Villers. Second Edition. 1957, Funk & Wagnalls Co., New York, N. Y. 488 p., 6¼ × 9¼ in., bound. $7.50. A study of the methods that can be used to provide effective profit control in an industrial enterprise. It describes in detail the profit and loss chart, the sales mixture chart, the break even chart, and the method of differential profit control and its applications. The fundamental principles involved in a study of industrial costs are given and special attention is paid to the use of electronic computers and to the use of mathematical methods in modern industrial management.

Extrusion of Plastics
By E. G. Fisher. 1958, Interscience Publishers, Inc., New York, N. Y. 114 p., 5³/₄ × 8³/₄ in., bound. $3.50. The principles of the extrusion process are presented along with information relating to single and multiscrew extrusion machines and their constructional features. Also included are discussions on materials for extrusion and the extrusion of thermosets.

Fundamentals of Gas Dynamics
(High Speed Aerodynamics and Jet Propulsion, Vol. III)
Edited by Howard W. Emmons. 1958, Princeton University Press, Princeton, N. J. 749 p., 6¼ × 9½ in., bound. $20. Presents those aspects of gas dynamics of most interest to modern aeronautical scientists. Topics discussed include equations of gas dynamics, one-dimensional treatment of both steady and nonsteady gas dynamics, hydrodynamic discontinuity phenomena, shock wave interactions, and condensation phenomena in high-speed flows. Additional sections are devoted to gas dynamics of combustion and detonation and to an analysis of the flow of rarefied gases.

The Future Supply of Oil and Gas
By Bruce C. Netschert. 1958, The Johns Hopkins Press, Homewood, Baltimore 18, Maryland. 134 p., 5½ × 8½ in., bound. $3. In place of the traditional forecast techniques such as the proved reserve concept, the author utilizes economic, technological, and geological variables to determine the future availability of oil and gas in the United States and the adjacent continental shelf through the period ending 1975.

Graphic Science
By Thomas E. French and Charles J. Vierck. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 758 p., 7³/₄ × 10¼ in., bound. $8.50. Provides an understanding of graphical methods as they relate to the problems of the engineer. The first part deals with engineering drawing, including the fundamentals of projection; the second, with descriptive geometry, including the solution of space problems of points, lines, planes, and surfaces. The third part covers graphical solutions, including nomography and empirical equations.

Guided Missiles
Sponsored by the Department of the Air Force. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 575 p., 9 × 11¼ in., bound

$8. A manual on the handling and operation of guided missiles. Topics included are: aerodynamics and propulsion of guided missiles as well as the physics involved in their design; guided missile control systems and their components; guided missile guidance systems; trajectory considerations and tactics; instrumentation. Methods are given for the maintenance and inspection of missiles.

The Gyroscope
By James B. Scarborough. 1958, Interscience Publishers, Inc., New York, N. Y. 257 p., $6^1/_4 \times 9^1/_4$ in., bound. $6.50. A study of the mathematical and mechanical aspects of the gyroscope. Following a discussion of the theory, specific applications are discussed, including vehicles and rotating bodies, direction indicating and steering, stabilizing, and astronomy. Vector methods are used throughout in the solution of problems.

Heat Transfer and Fluid Mechanics Institute, 1958
Preprints of Papers. Printed and distributed 1958 for the University of California by Stanford University Press, Stanford, Calif. 264 p., $6^3/_4 \times 9^3/_4$ in., paper. $7.50. Papers covering such areas as aerothermodynamics, fluid dynamics, dynamics of reactive fluids, heat transfer, magnetohydrodynamics, and hypersonics. The total of 21 papers provides an up-to-date review of advances in important sectors of the field.

The Impact of High Temperature Technology
By V. P. Kovicik and others. 1958, High-Temperature Associates, Cleveland Heights, Ohio. 272 p., $8^1/_2 \times 11$ in., paper. $8. Studies the present status of high-temperature technology, and attempts to indicate possible future developments. Areas covered are nuclear power, propulsion, component equipment, aircraft and missiles, electronics, temperature measurement, high-temperature process developments, and materials. A report written by graduate students under the guidance of the Harvard Business School Faculty.

Mathematical Theory of Compressible Fluid Flow
By Richard von Mises. 1958, Academic Press, Inc., New York, N. Y. 514 p., $6^1/_4 \times 9^1/_4$ in., bound. $15. The book is divided into five parts: introductory materials, general theorems, one-dimensional flow, plane steady potential flow, and integration theory and shocks. The general theory of characteristics with its applications is given detailed treatment as is the theory of shocks as asymptotic phenomena. The latter theory is set within the context of rational mechanics. A thorough presentation of the hodograph method is included. This is volume 3 of The Johns Hopkins Applied Physics Laboratory series "Applied Mathematics and Mechanics."

Motion and Time Study
By Benjamin W. Niebel. Revised Edition. 1958, Richard D. Irwin, Inc., Homewood, Ill., 494 p., $6^1/_4 \times 9^1/_4$ in., bound. $8.70. Presents the fundamentals of methods, time study, and wage payment with a view to providing substantial savings in labor and materials. In addition to proved techniques of work measurement, the author outlines the controls made possible once fair time standards have been developed. This edition gives increased emphasis to work sampling, indirect labor standards, curve plotting, and maintenance of standards.

Nonlinear Control Systems
By Robert L. Cosgriff. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 328 p., $6^1/_4 \times 9^1/_4$ in., bound. $9. Treats the nonlinear phenomena arising in the area of control systems. Topics discussed include the rise of techniques for linear systems with time varying parameters for determining the response of control systems; nonlinear systems excited by random input signals; reduction of statistical problems to differential equation form; and application of switching circuits in control systems. The approach to the subject is expedited by the use of the concepts and terminology of automatic-control theory rather than those of classical mechanics.

Thermal Properties of Thirteen Metals
By C. F. Lucks and H. W. Deem. Published 1958 as Special Technical Publication No. 227 by the American Society for Testing Materials, Philadelphia, Pa. 29 p., 6×9 in., paper. $1.25. Presents the results of a study conducted by the Battelle Memorial Institute to determine the following properties: thermal conductivity, thermal expansion, specific heat, density, and thermal diffusion. Aluminum, chromium, copper, Inconel, magnesium, molybdenum, and several steels are among the metals covered.

Thomas Telford
By L. T. C. Rolt. 1958, Longmans, Green and Co., London, England. 211 p., 6×9 in., bound. 25s. The story of a great Scotch engineer who built bridges, roads, aqueducts, and canals. The author has written a more detailed account than has hitherto been available, and at the same time has tried to present a portrait of Telford as a man. In addition to his great engineering feats, Telford served as first president of the Institution of Civil Engineers, and occupies a significant place in the history of engineering.

Aerodynamische Profile
By Friedrich W. Riegels. 1958, R. Oldenbourg, Munich, Germany. 278 p., $8^1/_2 \times 12$ in., bound. 138 DM. An extensive study of wing sections: fundamental theory; wind-tunnel test methods; influence of surface conditions, flaps, boundary layer, etc.; pressure distribution, uplift, and friction effects; aerodynamic calculations. Tables and graphs are given of the geometric and aerodynamic characteristics of hundreds of German, American (NACA), and British profiles. Each section includes a large list of references.

Aircraft and Missile Propulsion
Volume I: Thermodynamics of Fluid Flow and Application to Propulsion Engines. By M. J. Zucrow. 1958, John Wiley & Sons, Inc., New York, N. Y. 538 p., $6^1/_4 \times 9^1/_4$ in., bound. $11.50. This volume, the first in a three-volume work, covers the following areas: fundamental principles of thermodynamics; general characteristics of propulsion systems; thermodynamics of compressible fluid flow; flow through nozzles; flow through diffusers. A large number of illustrative problems are completely worked out.

Automatic Control: Principles and Practice
By Werner G. Holzbock. 1958, Reinhold Publishing Corporation, New York, N. Y. 258 p., $6^1/_4 \times 9^1/_4$ in., bound. $7.50. The first part of the book is concerned with the dynamic behavior of control systems, including static requirements and adjustments for peak performance. This is followed by a detailed description of electrical and mechanical components such as measuring elements, controllers, and control valves. Various control systems and their specific applications are then described. The approach is in terms of practical concepts rather than in mathematical terms.

Torsionstheorie
By Constantin Weber and Wilhelm Günther. 1958, Friedrich Vieweg & Sohn, Braunschweig, Germany. 307 p., $6^1/_2 \times 9^1/_2$ in., bound. 38 DM. A highly mathematical treatment of torsion theory which presents not only the well-known methods of solution of torsion problems in the field of elasticity but also certain original treatments devised by one of the authors. One major aim is to demonstrate which methods are most suitable for specific types of problems as well as to give detailed solutions.

Automatic Control Technology
1957, Instruments Publishing Company, Pittsburgh, Pa., 483 p., $8^1/_2 \times 11^3/_4$ in., bound. $25. Paper delivered at a symposium held at Heidelberg in 1956 by the VDI/VDE Fachgruppe Regelungstechnik. Among the aspects treated are: combining theory and practice by representation and technique; technology of controlling devices; multiple loop controls; linear methods in feedback control; evaluation of nonlinear and discontinuous controls; statistical methods; computers in feedback control; control of steam generators; industrial controls. Most of the papers are in English or German with German translations of the Russian papers included.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

THE Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretation was formulated at the Committee meeting September 12, 1958, and approved by the Board on October 31, 1958.)

Erratum

Case No. 1254 (Special Ruling), under Chemical Composition, revise "Magnesium 2.00 max per cent" to read "Manganese 2.00 max per cent."

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Power Boilers, 1956

PAR. P-12(b) Revise lines 8 and 9 to read:

". . . does not exceed 450 F, except for the blowoff connections, see Par. P-310."

PAR. P-12(c) Add after "exceed 450 F" in line 6, "except for the blowoff connections, see Par. P-310."

PAR. P-12(d) Add the following paragraph:

(d) Cast nodular iron as designated in Specification SA-395 may be used for pressure parts at pressures not exceeding 350 psi provided the steam temperature does not exceed 450 F, except for the blowoff connections, see Par. P-310.

PAR. P-23(a) Under definitions of E, add additional term for reference as follows:

E = for all riveted construction the values and formulas of Par. P-180(b) shall apply.

PAR. P-321 Revise the first paragraph, third sentence, to read:

Water columns made of malleable iron in accordance with Specification SA-47 or Cast Nodular Iron in accordance with Specification SA-395 may be used for maximum boiler pressures not exceeding 350 psi.

Unfired Pressure Vessels, 1956

PREAMBLE Delete except for a statement covering date of approval by the Council of the Society.

PAR. UG-91 Add a new sentence after the first sentence to read:

The inspector shall not be in the employ of the manufacturer.

FIG. UCS-67 Typical Sections of Special Seamless Containers Delete this figure.

PAR. UCS-66 Delete subparagraph (c).

PAR. UCS-67 Delete subparagraph (e).

TABLE UCS-23 Add the accompanying stress values and new Notes.

STRESS VALUES TO BE ADDED TO TABLE UCS-23

Material and Specification Number	Grade	Nominal Composition	P-Number	Spec. Min Tensile	Notes	For Metal Temperatures Not Exceeding, Deg F —20 to 650
FORGINGS						
Carbon Steels						
SA-372	I	.....	P-1	60,000	(20)(23)	See Note 24
SA-372	II	.....	...	75,000	(20)(22)(23)	"
SA-372	III	.....	...	90,000	(20)(22)(23)	"
Low Alloy Steels						
SA-372	IV	1/4 M	...	105,000	(20)(22)(23)	"
SA-372	V (A&B)	1 Cr-1/4 M	...	120,000	(21)(23)	"
SA-372	V (C&D)	1/2 Cr-1/2 Ni-1/4 M	...	120,000	(21)(23)	"
SA-336	(All Grades)	.....	...	...	(23)	—

(20) Stress values apply to normalized, or normalized and tempered or oil-quenched and tempered material only, as per applicable specification.
(21) Stress values apply to quenched and tempered material only, as per applicable specification.
(22) Welding not permitted when carbon content exceeds 0.35 per cent by ladle analysis except for repairs or non-pressure attachments as outlined in Part UF.
(23) Welding or brazing not permitted on liquid quenched and tempered material.
(24) Maximum allowable stress values shall be as follows:

	Liquid Quenched and Tempered —20 to 200 F	Other than Liquid Quenched and Tempered —20 to 650 F
I	15,000	15,000
II	18,750	18,750
III	22,500	22,500
IV	26,250	26,250
V (A&B)	30,000	...
V (C&D)	30,000	...

PAR. P-245 Delete this paragraph.

PAR. P-246 Delete this paragraph.

Material Specifications, 1956

The Boiler and Pressure Vessel Committee has approved adding to Section II the following:

SA-233-58T Mild Steel Arc-Welding Electrodes

SA-316-58T High-Tensile and Low-Alloy Steel-Covered Arc-Welding Electrodes

PAR. UNF-23(c) Revise to read:

When welding or brazing is to be done on material having increased tensile strength produced by heat-treatment, the allowable stress value for the material in the annealed condition shall be used for the joint design unless the stress values for welded construction are given in the Table UNF-23, or unless the finished construction is subjected to the same heat-treatment as that which produced the temper in the "as-received" material and provided the welded joint and the base metal are similarly affected by the heat-treatment.

TABLE UNF-23 Replace present Aluminum and Aluminum Alloy Products Table with the accompanying revised table.

TABLE UNF-23 MAXIMUM ALLOWABLE STRESS VALUES IN TENSION FOR NONFERROUS METALS, IN POUNDS PER SQUARE INCH

ALUMINUM AND ALUMINUM ALLOY PRODUCTS

Specification Number	Alloy Designation ASTM	Alloy Designation ASA	Temper	Specified Minimum Tensile Strength, psi	Specified Minimum Yield Strength, psi	Notes	For Metal Temperatures Not Exceeding Deg F 100	150	200	250	300	350	400
SHEET AND PLATE													
SB-209	990A	1100	O	11000	3500	...	2350	2350	2300	2100	1850	1600	1300
			H112	12000	5000	(1)(3)	3000	2800	2550	2250	2000	1700	1400
			H12	14000	11000	(1)	3500	3400	3150	2900	2650	2400	1700
			H14	16000	14000	(1)	4000	3900	3650	3300	3000	2700	1700
SB-209	996A	1060	O	9500	2500	...	1650	1650	1600	1450	1250	1200	1050
			H112	10000	4000	(1)(2)	2500	2150	1950	1700	1500	1300	1100
			H12	11000	9000	(1)	2750	2550	2350	2100	1900	1600	1400
			H14	12000	10000	(1)	3000	3000	2900	2700	2350	2000	1600
SB-209	G1A	5050	O	18000	6000	...	4000	4000	4000	4000	4000	3350	2100
			H112	20000	8000	(1)	5000	5000	5000	4900	4500	3700	2100
			H32	22000	16000	(1)	5500	5500	5500	5350	4800	3800	2100
			H34	25000	20000	(1)	6250	6250	6200	6050	5400	3950	2100
SB-209	GR20A	5052	O, H112	25000	9500	...	6250	6250	6200	6000	5400	4650	3500
			H32	31000	23000	(1)	7750	7750	7650	7100	6400	5600	3500
			H34	34000	26000	(1)	8500	8500	8400	7700	6900	6100	3500
SB-209	GR40A	5154	O	30000	11000	(9)	7350	7350	7350	7000	6400	...	...
			H112	30000	11000	(1)(9)	7350	7350	7350	7000	6400	...	...
			H32	36000	26000	(1)(9)	9000	8950	8850	8250	7400	...	...
			H34	39000	29000	(1)(9)	9750	9700	9500	8800	7900	...	...
SB-209	GS11A	6061	T4	30000	16000	(5)	7500	7200	7000	6700	6400	5600	4000
			T6	42000	35000	(5)	10500	10200	9900	9400	7900	6200	4400
			T6 welded	24000*	...	...	6000	5900	5700	5400	5000	4200	3200
SB-209	Clad GS11A	Alclad 6061	T4	27000	14000	(5)	6800	6500	6200	6000	5800	5100	3600
			T6	38000	32000	(5)	9500	9200	9000	8500	7200	5600	4000
			T6 welded	24000	...	...	6000	5900	5700	5400	5000	4200	3200
SB-209	M1A	3033	O	14000	5000	...	3350	3150	2900	2700	2400	2100	1800
			H112	14500	6000	(1)(4)	3600	3250	3000	2800	2500	2200	1900
			H12	17000	12000	(1)	4250	4000	3800	3600	3300	3000	2650
			H14	20000	17000	(1)	5000	4850	4700	4400	4000	3500	3100
SB-209	Clad M1A	Alclad 3033	O	13000	4500	...	3000	2900	2700	2500	2200	2000	1700
			H112	14500	6000	(1)(4)	3600	3200	3000	2800	2500	2200	1900
			H12	16000	11000	(1)	4000	3800	3600	3400	3100	2800	2500
			H14	19000	16000	(1)	4800	4600	4400	4200	3800	3400	2900
SB-209	MG11A	3004	O	22000	8500	...	5500	5500	5500	5200	4450	3600	2950
			H112	23000	9000	(1)	5750	5750	5750	5500	4650	3850	3150
			H32	28000	21000	(1)	7000	7000	7000	6550	5800	5050	3500
			H34	32000	25000	(1)	8000	8000	8000	7400	6550	5600	3500
SB-209	Clad MG11A	Alclad 3004	O	21000	8000	...	5250	5250	5200	5000	4350	3450	2800
			H112	22000	8500	(1)	5500	5500	5500	5200	4400	3700	3000
			H32	27000	20000	(1)	6800	6800	6800	6300	5600	4900	3400
			H34	31000	24000	(1)	7800	7800	7700	7200	6300	5400	3400
BARS, RODS AND SHAPES													
SB-211, SB-221	CG42A	2024	T4	60000	40000	(5)(6)	15000	14300	13700	12000	9100	5700	3950
SB-211, SB-221, SB-308	GS11A	6061	T6	38000	35000	(5)	9500	9200	9000	8500	7200	5600	4000
			T6 welded	24000*	...	...	6000	5900	5700	5400	5000	4200	3200
SB-221	GR40A	5154	O	30000	11000	(9)	7350	7350	7350	7000	6400	...	...
			H112	30000	11000	(9)	7350	7350	7350	7000	6400	...	...
BOLTING MATERIALS													
SB-211	GS11A		T6	42000	35000	(5)	8400	8200	7900	7500	6300	4900	3300
			T6 Welded	24000*	...	...	4800	4700	4660	4400	4000	3400	2600
SB-211	CG42A	.....	T4	62000	40000	(7)	10000	9700	9400	9000	7800	6200	4600
SB-211	CS41A	.....	T6	65000	55000	(7)	13000	12200	11600	10400	7200	4400	3000
PIPE AND TUBE													
SB-210, SB-235	996A	1060	O	9500	2500	...	1650	1650	1600	1450	1250	1200	1050
			H112	10000	4000	(1)	2500	2150	1950	1700	1500	1300	1100
SB-210, SB-234	996A	1060	H14	12000	10000	(1)(8)	3000	3000	2900	2700	2350	2000	1600
SB-210, SB-235	GR40A	5154	O	30000	11000	(9)	7350	7350	7350	7000	6400	...	...

* Strength of full-section tensile specimen required to qualify welding procedures. See Par. QN-6.

TABLE UNF-23 MAXIMUM ALLOWABLE STRESS VALUES IN TENSION FOR NONFERROUS METALS, IN POUNDS PER SQUARE INCH *(Continued)*

ALUMINUM AND ALUMINUM ALLOY PRODUCTS

Specification Number	Alloy Designation ASTM	Alloy Designation ASA	Temper	Specified Minimum Tensile Strength, psi	Specified Minimum Yield Strength, psi	Notes	For Metal Temperatures Not Exceeding Deg F 100	150	200	250	300	350	400
SB-210	GR40A	5154	H34	39000	29000	(9)	9750	9700	9500	8800	7900	...	...
SB-235	GS10A	6063	T42	17000	10000	(5)	4200	4200	4200	4200	4000	3100	2000
SB-235, SB-241	GS10A	6063	T5	22000	16000	(5)	5500	5100	4900	4600	4200	3100	2000
SB-210, SB-238, SB-241	GS10A	6063	T6	30000	25000	(5)	7500	7100	6800	6100	4500	3100	2000
SB-210, SB-235, SB-241	GS10A	6063	T6 welded	17000	...	...	4250	4200	4000	3800	3600	2750	1900
SB-210, SB-234, SB-235	GS11A	6061	T4	26000	16000	(5)	6500	6200	6000	5800	5600	4900	3500
SB-210, SB-234, SB-235, SB-241	GS11A	6061	T6	38000	35000	(5)	9500	9200	9000	8500	7200	5600	4000
SB-210, SB-234, SB-235, SB-241	GS11A	6061	T6 Welded	24000	...	...	6000	5900	5700	5400	5000	4200	3200
SB-210, SB-235	M1A	3003	O	14000	5000	...	3350	3150	2900	2700	2400	2100	1800
SB-235, SB-241	M1A	3003	H112	14500	6000	(1)	3600	3250	3000	2800	2500	2200	1900
SB-210	M1A	3003	H14	20000	17000	(1)	5000	4850	4700	4400	4000	3500	3100
SB-210, SB-241	M1A	3003	H18	27000	24000	(1)	6750	6400	6050	5700	5250	4400	3500
SB-210	Clad M1A	Alclad 3003	O	13000	4500	...	3000	2900	2700	2500	2200	1950	1700
SB-235	Clad M1A	Alclad 3003	H112	13500	5500	(1)	3400	3000	2800	2600	2300	2000	1750
SB-210, SB-234	Clad M1A	Alclad 3003	H14	19000	16000	(1)	4750	4600	4450	4200	3800	3350	2900
SB-210	Clad M1A	Alclad 3003	H18	26000	23000	(1)	6500	6100	5800	5500	5080	4200	3350
FORGINGS													
SB-247	CS41A	2014	T4	55000	30000	(5)	13800	12800	12000	11000	10200	5750	3900
			T6	65000	55000	(5)	16200	15200	14400	14000	11300	5750	3900
SB-247	GS11A	6061	T6	38000	35000	(5)	9500	9200	9000	8500	7200	5600	4000
			T6 Welded	24000*	...	...	6000	5900	5700	5400	5000	4200	3200
SB-247	GS11B	6053	T6	36000	30000	(5)	9000	8400	7900	7300	6100	4700	3200
SB-247	M1A	3003	F	14000	5000	...	3350	3150	2900	2700	2400	2100	1800

* Strength of full-section tensile specimen required to qualify welding procedures. See Par. QN-6.

NOTES:

(1) For welded construction, stress values for O material shall be used.
(2) For nominal thicknesses not greater than 0.500 in. the stress values for H14 material may be used; for nominal thicknesses of 0.501 to 1.000 in. the values for H12 material may be used; for thicker material the values listed shall be used.
(3) For nominal thicknesses not greater than 2.000 in.; for thicker material the stress values for O material shall be used.
(4) For nominal thicknesses not greater than 0.500 in. the stress values for H12 material may be used; for thicker material the values listed shall be used.
(5) The stress values given for this material are not applicable when either welding or thermal cutting is employed.
(6) For nominal thicknesses not less than 0.25 in.
(7) See Pars. UNF-12 and UNF-23.
(8) For nominal thicknesses not greater than 0.500 in.
(9) See Par. NF-13(b).

Welding Qualifications, 1956

APPENDIX I—Add the following definitions:

Preheating—The application of heat to the base metal prior to welding or cutting operation.

Interpass Temperature—In a multiple-pass weld, the lowest temperature of the deposited weld metal before the next pass is started.

Postheating—The application of heat to a weld or weldment subsequent to a welding or cutting operation.

TABLE Q-11.2 Include specifications SA-233 and SA-316 under the following classifications:

EXX24	EXX14	EXX18
EXX27		
EXX28		
F1	F2	F4

Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

Engineers View Soviet Electric Power Development

See Hydroelectric, Thermal, and Nuclear Operations

IN CO-OPERATION with the state department, and under sponsorship of the Edison Electric Institute and the Association of Edison Illuminating Companies, Walker L. Cisler, Fellow ASME, recently organized and led a group of ten Americans in a 4000-mile trip within the Soviet Union to study the production of electric power, its transmission, distribution, and use. Through their companies and trade organizations, the executives who made the trip represented about 80 per cent of the American electric power industry, as well as a substantial share of the manufacture of heavy electrical equipment, and appliances.

They included Harvey E. Bumgardner, Mem. ASME, chairman of the Edison Electric Institute's Committee on Technical Exchanges for Overseas Visitors; Gwilym A. Price, Affiliate ASME, chairman of the board of Westinghouse; Philip D. Reed, chairman of the finance committee of General Electric; Joseph L. Singleton, Mem. ASME, executive vice-president of Allis-Chalmers; James F. Davenport, executive vice-president of Southern California Edison; Donald S. Kennedy, president of Oklahoma Gas and Electric; Elmer L. Lindseth, Fellow ASME, chairman of the Edison Electric Institute Committee on Atomic Power and president of Cleveland Electric Illuminating; R. George Rincliffe, Fellow ASME, president of Philadelphia Electric; and Edwin Vennard, vice-president and managing director of the Edison Electric Institute.

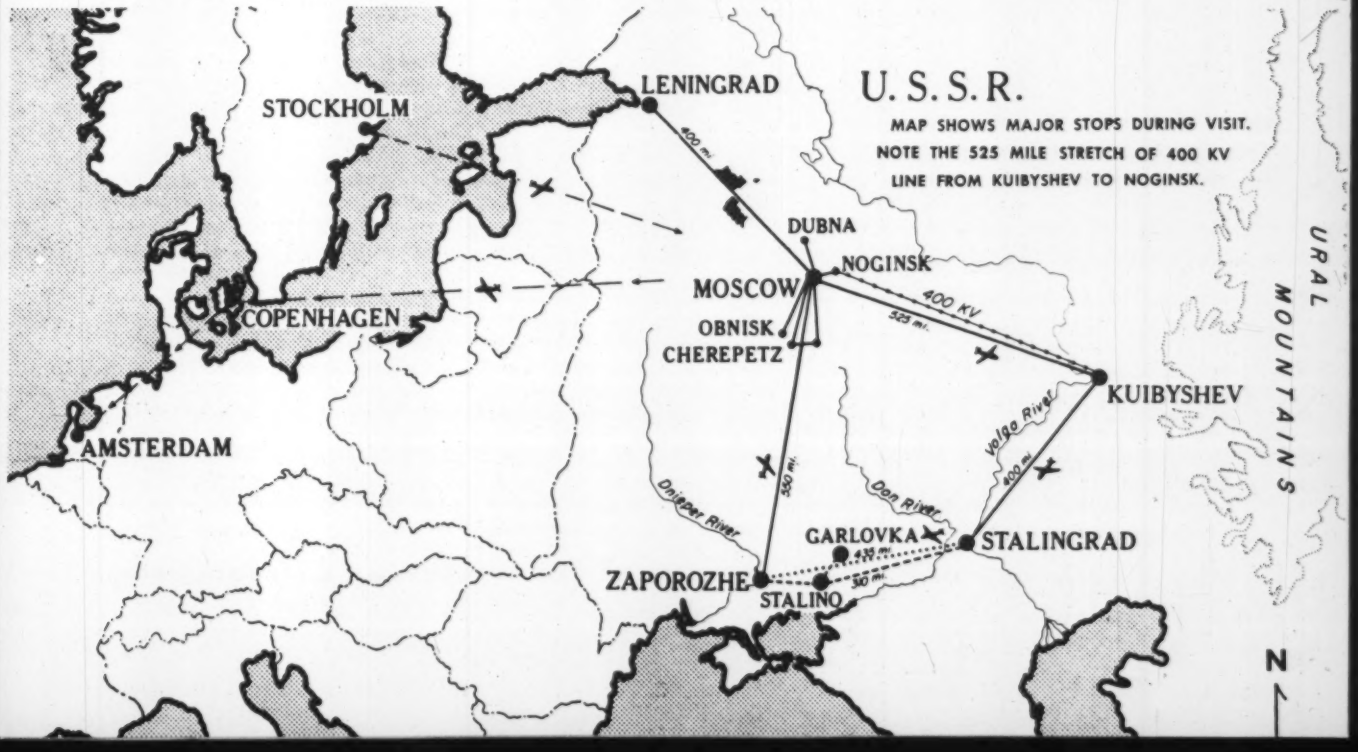
A booklet describing the visit has been prepared by The Detroit Edison Company.

The group reported that they were readily, warmly, and cordially received by the top responsible people in electric power, including A. S. Pavlenko, Minister of Power Stations who succeeded Malenkov in that position and who led the USSR national committee at World Power Conference, Montreal.

The Soviets showed their plants and answered questions. The engineering thinking of the two countries, the group found, is sometimes remarkably close together in method and often close in solving the basic problems. In some respects we can learn from them; in other respects they can learn from us.

Rapidly Expanding Capacity

In the normal course of events the USSR should expand its power-generating capacity, and its economy, at a substantial rate. The power plants shown during the trip were part of systems which have a total capacity of 48.3-million kw. This is for a population of more than 200 million, spread through 15 republics, over distances greater than those in the United States. It compares, as of the beginning of this year, with about 150 million kw being used by 175,000,000 Americans.



Visitors at Noginsk 400-kv substation make photographic record of inspection tour

American power company presidents leave Russian nuclear power headquarters

Those simple statistics give a picture of Soviet economy, productive strength, or standard of living, depending on which term you prefer.

Until recently the USSR has been doubling its electric-power capacity every five years. Now they are in the process of doubling every six or seven years, compared with every ten years in the U. S.

Percentagewise the U. S. is not increasing as rapidly as the Soviets. Where we must keep pace with the continuing growth of our economy, the USSR still must make up for lost time.

In America, roughly a third of our electric power is for domestic use; another third for commercial uses; a third for industrial use. The precise use of the USSR's power is not known but the visible signs indicate that more goes into industry and less into domestic use. Refrigerators and other electric appliances are not yet the household necessity that we have made them in the United States. Hotels have elevators but they have not been installed in every apartment building.

By 1965 or 1966 the USSR expects to have generators producing 60 million kw of electricity in addition to the 48.3 million kw it had at the beginning of 1958. The visiting group could see no reason why they should not accomplish this. They might, perhaps, do it even sooner, but the Soviets have other problems.

This capacity will be added primarily with conventional plants driven mostly by steam boilers and to a lesser extent by water power. At present, the USSR derives about 20 per cent of its electricity from hydro power, such as Dnieperstroi. Fossil fuels provide the energy for all the rest. This is essentially the same proportion as in the United States. The trend is away from hydro power and only 15 per cent of the new plants will be water-driven. Thermal plants have lower capital cost and can be built more quickly.

The Soviets amortize their investments such as power plants, paying off the initial cost out of income from the sale of power over perhaps 25 or 50 years. They do not recognize interest in the sense we do, but they keep sound accounts of what power costs to produce.

Kuibyshev Hydro Plant

On August 8, only a few days before the group arrived in Moscow, Khrushchev dedicated the new Kuibyshev hydro plant on the Volga. The Americans saw it and were impressed. Engineers had created a lake 300 miles long and at some points 24 miles wide, moving 200 villages out of the way. The water drives 20 generators, each producing 115,000 kw, a total of 2,300,000 kw making the plant the world's largest, surpassing even our Grand Coulee and its 1,900,000 kw. It took seven years to build and the cost was $400 per kw or more than $900 million. The length of time required to build this plant and the total cost of the project were part of the reason for the trend to minimize hydroelectric power. However, they do believe that some more hydro plants on the Volga will be practicable.

Many conventional steam boiler plants were seen in Moscow and other areas. One of the newest had three 150,000-kw units with a fourth unit to be added. They have 56 units of 100,000 kw in the country, all manufactured in the USSR.

American units are larger, but on the other hand, the Soviets are completing one 200,000-kw steam-turbine generator unit, designing one of 300,000 kw, and doing research aimed at units of 400,000 and 600,000 kw. They are doing a great deal of prefabricating of parts, and all in all, no engineer can help but have respect for the way the Soviets are building.

Throughout the 4000-mile trip examples of Soviet readiness to find new engineering frontiers to conquer were constantly seen.

Transmission of power is far from easy. Lines carrying 110,000 and 220,000 volts are common in the USSR and they have already gone to higher voltages. The Soviets have two 400,000-volt lines from their Kuibyshev plant to Moscow, a distance of about 600 miles, and later will change these to 500,000 volts. A 200,000-volt d-c line is in operation over a span of 100 kilometers (about 60 miles) for assembling technical data and experience in high-voltage d-c lines.

In 16 days in the USSR only the European portion of the country could be covered—a 2500-mile swing by air from Moscow to Kuibyshev to Stalingrad, across the important Don Basin and back to Moscow, and then another flight of 900 miles to Leningrad and back. This is only a part of the vast stress over which the Soviets must transmit power.

They are efficiently developing new thermal generating plants, and in their research institutes are working on high temperatures and high steam pressures and are doing outstanding work.

Nuclear Power

Although it will be years before nuclear power is economic, the USSR is not lagging in the understanding of either fission or its more powerful partner, fusion. The Soviet 5000-kw atomic plant about 70 miles from Moscow, which has been in operation since 1954, was visited. It is being used for research as well as to produce power. (The hosts did not mention the 100,000-kw reactor in Siberia announced a few days later at Geneva.)

A site is being prepared near Moscow for a large new nuclear power plant, and others are being planned in the Urals and near Leningrad. These plants will be of differing types, and one will be of 400,000-kw capacity—four units with a separate reactor for each, one rated at 200,000-kw and three at 70,000-kw each.

The Americans saw research facilities, including the 10-Bev synchrocyclotron 62 miles from Moscow, and some of the equipment for the atom-powered ice breaker at Leningrad, and research work on breeder reactors.

On this, their thinking and ours come very close together. They feel, as we do, that success lies in the use of plutonium as fuel for atomic-power production, coupled with the employment of breeder reactors. Such reactors can take ordinary uranium with an enriched core at the center, and from it not only derive power but also breed plutonium for new fuel.

Report of Fifth UPADI Convention, Montreal, Canada, Sept. 2–6, 1958

One hundred and eight engineers representing sixteen countries in the Western Hemisphere met in Montreal, Canada, September 2–6, 1958, for the Fifth UPADI Convention. Host for the meeting was the Engineering Institute of Canada. The official delegate from ASME was George Browne, editor of *Industria*.

K. F. Tupper (Canada) was selected president of the Convention with Saturnino de Brito, filho (Brazil), Miguel A. Mantilla (Mexico), and Enoch Needles (U. S. A.) as vice-presidents.

Three organizations sent special representatives to the Convention: the Organization of American States, FEANI (a European federation of Engineering societies), and the Council for International Progress in Management (U. S. A.).

The Hon. Sidney Smith, Secretary of State for External Affairs, greeted the Convention on behalf of the Dominion Government. The Hon. Sarto Fournier, Mayor of Montreal, welcomed the delegates to the city and extended an official reception to them in the Hall of Honor at the Hotel de Ville. The Engineering Institute of Canada offered a reception, and the Convention ended with a reception and dance at the University of Montreal.

Engineering Education Conference

A Conference on Engineering Education under the chairmanship of Ralph A. Morgen (U. S. A.) was the high light of the Convention. Papers were presented by Canada, Brazil, Mexico, and the United States. They were followed by a general discussion. The Conference developed a program of investigation, the results of which are to be reported at a special Pan-American Engineering Education Congress to be held in conjunction with the Sixth UPADI Convention.

The aim of the study is to develop standards of practice and procedure for engineering schools throughout the Hemisphere. Each member is asked to report on:

(*a*) Admission requirements to schools of engineering.

(*b*) How changes are made in curriculums and who is responsible for them.

(*c*) Practices in faculty recruitment and promotion; definitions of working conditions.

(*d*) Recognition of engineering degrees.

(*e*) Co-ordination of graduate and research programs with productive needs of the country.

In the field of engineering education the Convention also resolved to investigate the establishment of regional centers for scientific study and for specialization in engineering. It urged the development of a scholarship program and requested consideration of a proposal to participate in the International Association for the Exchange of Students for Technical Experience.

Technical Dictionary

The delegates welcomed the information that progress was being made by the Pan-American Committee on Technical Standards in its work on technical dictionaries and once again demanded universal adoption of the metric system. They recommended the appointment of engineering attachés at embassies and co-operation with the International Arbitration Association.

In all, the Convention passed 47 resolutions, most of them dealing with internal organization, relations with the Organization of American States, and finance. Eight resolutions dealt with the question of exchange of information.

At the closing session, Argentina, Brazil, and the United States were re-elected to the Board of Directors, and Argentina was designated as the site of the Sixth Convention in 1960.

COMING MEETINGS

Case OR Course

Operations research, a scientific method for making effective management decisions, will be the subject at a ten-day, introductory short course at Case Institute of Technology, Jan. 19–30, 1959.

Designed for men with research experience and an understanding of mathematical symbolism, the course will outline areas in which OR methods, tools, and techniques are important in American business and industry.

Fee for the course is $375, which includes all instructional fees, ten luncheons, six dinners, textbook and classroom supplies. Living quarters are available at the expense of the registrant.

Inquiries and applications should be addressed to Dr. E. Leonard Arnoff, Assistant Director, Operations Research Group, Case Institute of Technology, Cleveland 6, Ohio.

Nuclear Fuel Cycles

The Institute of Physics, a constituent body of the British Nuclear Energy Conference, has arranged a "Nuclear Fuel Cycles" Symposium in London, England, Jan. 22-23, 1959.

Papers will cater to persons working in the field and will deal with the applied physics aspects of the fuel cycles which form the basis of the immediate nuclear program. Abstracts (but not preprints) of the papers will be available early in January.

Applications are available from the Secretary of the Institute of Physics, 47 Belgrave Square, London S.W. 1, England.

IEE Invites Papers

The Institute of Environmental Engineers invites papers for its 1959 annual meeting to be held in April, 1959. Papers covering every aspect of environmental simulation and testing are of interest.

Prospective speakers should write to Raymond G. Yaeger, Chrysler Corporation, Missile Division, P. O. Box 2628, Detroit 31, Mich.

MEETINGS OF OTHER SOCIETIES

Dec. 7–10

American Institute of Chemical Engineers, annual meeting, Netherlands-Hilton Hotel, Cincinnati, Ohio.

Dec. 8–10

American Nuclear Society, winter meeting, Sheraton-Cadillac Hotel, Detroit, Mich.

Dec. 17

Institute of the Aeronautical Sciences, Wright Brothers Lecture, Smithsonian Natural History Building, Washington, D. C.

Dec. 17–19

American Society of Agricultural Engineers, winter meeting, Palmer House, Chicago, Ill.

Dec. 26–31

American Association for the Advancement of Science, 12th annual meeting, Sheraton Park Hotel, Washington, D.C.

(*ASME Coming Events, see page 130*)

Hot Laboratory Equipment

"Hot Laboratory Equipment," a 429-page book, with 351 illustrations, gives detailed descriptions and design for facilities, equipment, and accessories used in handling moderate to large amounts of radioactive materials. The book, compiled by L. G. Stang, Jr., Brookhaven National Laboratory, is an enlarged and modern version of "The Hot Laboratory Catalog," first edition. Released by the U. S. Atomic Energy Commission, the book may be purchased for $2.50 from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Mild Steel Electrodes

CHANGE in the "Specification for Mild Steel Arc Welding Electrodes," are contained in the new booklet prepared by the American Welding Society and the American Society for Testing Materials. Copies cost 50 cents, and may be obtained from the Technical Department, American Welding Society, 33 West 39th Street, New York 18, N. Y.

AIIE Research Abstracts

THE American Institute of Industrial Engineers has published the first series of abstracts of research performed in the field of industrial engineering.

The ultimate objective of the Research Information Committee, AIIE, is to obtain a complete compilation of all completed industrial-engineering research work. A second survey concerning research completed between July 1, 1947 and July 1, 1952 is about to begin. The committee would appreciate receiving research abstracts of work performed during this period. Direct information and inquiries to: Research Information Committee, AIIE Department of Industrial Engineering, Washington University, St. Louis 5, Mo.

USSR Serials

"SERIAL Publications of the Soviet Union, 1939–1957," is a bibliographic checklist which attempts to include all government and nonofficial serial publications appearing in the USSR since 1939. Published by the Library of Congress, the 459-page paper-bound book costs $2.75, and may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

New "Marks"

"MARKS' Mechanical Engineers' Handbook," sixth edition, has been completely revised and modernized. Prepared by a staff of specialists with Theodore Baumeister, Assoc. Mem. ASME, as editor-in-chief, the new book has 2320 pages, and is illustrated. Published by the McGraw-Hill Book Company, Inc., the book costs $23.50.

Nuclear Engineering

A "NUCLEAR Engineering Handbook" has been prepared by a staff of 70 specialists, and edited by Harold Etherington, Mem. ASME. The 1857-page book has 706 illustrations and 552 tables. Published by McGraw-Hill Book Company, the volume costs $25.

Stationary Diesel and Gas Engines

A NEW edition of "Standard Practices for Stationary Diesel and Gas Engines," has recently been published by the Diesel Engine Manufacturers Association, 2000 K Street, N.W., Washington 6, D. C. The 220-page, illustrated book costs $5. Chapters in the previous editions of the book have been enlarged to include such significant recent developments as high-compression gas engines, new supercharging systems, and so on.

Engineering Aptitude

"Do I Have Engineering Aptitude?" is a guidance questionnaire for prospective engineering students. A. P. Johnson, Mem. ASME, Newark College of Engineering, has prepared the pamphlets which are available, in quantity, from the Engineers' Council for Professional Development, 29 West 39th Street, New York 18, N. Y. Cost of 50 pamphlets is $2, with a 20 per cent discount on orders of 100 or more. Individual requests on official letterheads will be honored when accompanied by a stamped, self-addressed, size 10 envelope. Address individual requests to: Dr. F. A. Russell, Meetings Secretary, Newark College of Engineering, 367 High Street, Newark 2, N. J.

Engineers' Salary Report

"THE most comprehensive report on salaries of engineers ever published in the U. S. will be issued by Engineers Joint Council in December," according to D. S. Bridgman, chairman, EJC Surveys Committee. Based on a survey conducted by the Engineering Manpower Commission of EJC, the study will present salary structures of close to 800 companies and government organizations, grouped by principal product or service. The breakdown will include some 20 industrial activities as well as municipal, state, and federal government. Data on over 5000 engineering faculty members will also be featured. Special tables will be presented on engineers with master and doctorate degrees.

The data will be derived from the largest sample ever studied including some 150,000 engineers in all activities. EJC is now accepting advance orders for mailing of full report including tables and charts promptly after publication. Price is $3 a copy, quantity discounts on request.

Nuclear Power

● ENGINEERS in the nuclear energy field now have an additional source of detailed information on all major reactor plants, here and abroad. The American Society of Mechanical Engineers began, in March, to publish a series of books containing up-to-date design and construction data on reactors. The first volume of the series, "Power Reactors," covers 16 units used for generation of power.

The volume presents information about the types of reactor plants and their experimental prototypes that are designed to produce electric power. It contains both general information and specific technical data, presented for each plant on identical data-sheet forms.

The information represents the latest power-reactor data available to the committee at the time of printing; and includes such subjects as: general descriptions, power data, fuel elements and blanket, and so on. It was obtained from replies to questionnaires which were sent to all known power-reactor and prototype power-reactor projects. A schematic flow diagram for each system has been included where possible.

The series, under the sponsorship of the Reactor Plant Data Committee of the ASME Nuclear Engineering Division, will include not only data on new plants, but also revised data on current efforts as they progress through the design stage. The committee has begun preparation of the second book of the series which will cover research and testing reactors.

"Power Reactors" is priced at $3, and is available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

● A COMPREHENSIVE collection of current information on nuclear reactors—their design, construction, and operation—and operation of "hot" laboratories,

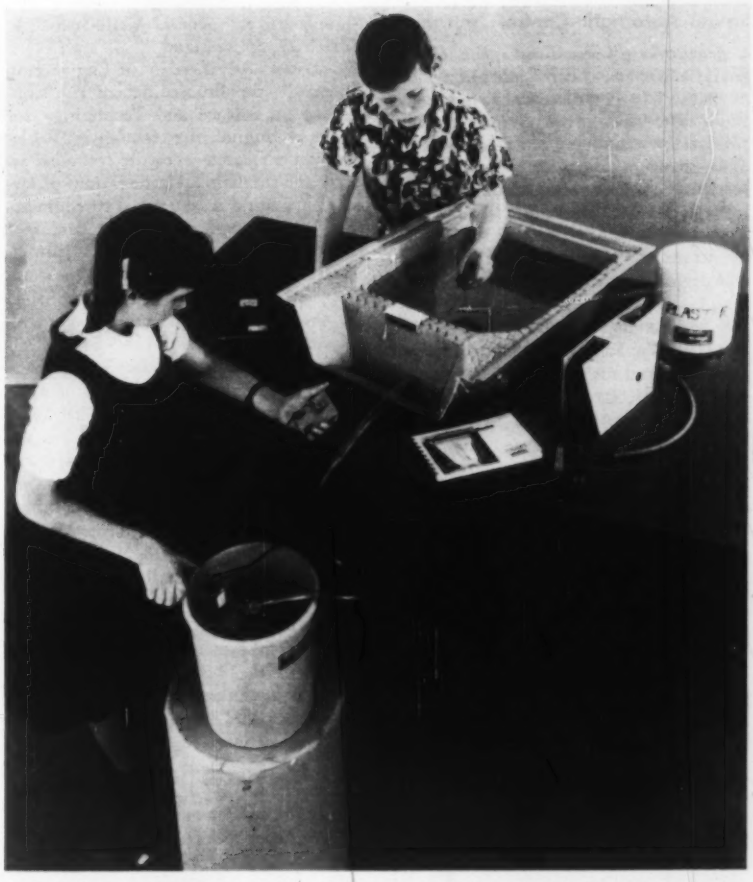
Learn-by-Doing Aid to Science Teaching

LITTLE acorns make great oaks, and Olive G. Mayer, Assoc. Mem. ASME, knows it. Amid all the discussion about the crisis in American education, Mrs. Mayer has been working on this problem. She has been contributing to a solution by taking an approach frequently overlooked in the current debate. It is basic, simple, and sensible. Her approach—begin with the children, begin when imaginative and eager minds are open to the fascinations of science, begin before the groundless phobia and apathy toward science take roots.

Toward this end, Mrs. Mayer, a graduate mechanical engineer, founded the Product Design Company, Redwood City, Calif., three years ago. The company designs and manufactures science-teaching aids. Aimed at the fifth to eighth-grade groups, the company provides scientific equipment that makes science meaningful, challenging, and understandable. Essentially, their products are working models of engineering processes that are interesting and readily understood by children. With these versatile models, students learn scientific principles by performing planned experiments, and are motivated to further express their own ingenuity and creativeness.

The company's newest teaching aids are a series of products on the subject of electricity. The focal point of the series is a model hydroelectric dam and generator kit. A molded polystyrene dam reservoir is provided, with materials for pupils to construct their own dam. Extensive use of clear plastic in the generator unit permits full observation of all working parts. An intake tower controls the flow of water through the penstock to operate the turbine generator. The generator unit will also work independently off any faucet outlet. Six volts a-c current are generated—sufficient to light a lamp, ring a bell, or operate a small d-c motor. Accessories include a rectifier and d-c motor, transmission lines and transformer, ammeter, voltmeter, a hydraulic kit, and a kit for teaching magnetism.

For the teachers (many of whom are not trained in the sciences), a detailed manual, prepared and edited by science teachers, is provided.



Grade-school students study hydroelectric power with the aid of a hydroelectric dam and generator kit made by the Product Design Company, owned by Olive G. Mayer, Assoc. Mem. ASME

for handling of radioactive materials, has been made available for distribution to all interested persons, by The American Society of Mechanical Engineers.

The books are based on papers presented at the 1957 Nuclear Congress, a joint meeting held in Philadelphia, Pa., under the auspices of 25 major scientific and technical groups.

Volumes 1 and 2, titled "Advances in Nuclear Engineering," were edited by Dean J. R. Dunning, Mem. ASME, Columbia University, and Bruce R. Prentice, Mem. ASME, General Electric Company, and chairman, the Nuclear Congress Program Committee. They deal with the design of nuclear reactors and their cores, educational use of reactors, metallurgy, instrumentation, heat transfer, problems of corrosion and materials, and related topics. The two volumes, containing over 1100 pages and more than 900 illustrations, are sold as a set for $35. Most of the 138 articles in volumes 1 and 2 are also available in single-copy format at 30 cents each.

The third volume, "Hot Laboratory Operation and Equipment," edited by Frank Ring, Jr., of Oak Ridge National Laboratory, contains the most complete information currently available on devices and techniques for handling radioactive materials.

Priced at $17.50, the 376-page volume contains over 60 articles with 284 illustrations.

The three volumes are available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. All three volumes may be purchased at the special rate of $45.

Futher information on the volumes, including a list of specific articles and authors contained in volumes 1 and 2, may be obtained from the same address.

Soviet Automatic-Control Journal

Avtomatika I Telemekhanika, the leading Soviet automatic-control journal, is now available in a complete English translation. The new cover-to-cover translation at low cost has been made possible by a grant-in-aid to the Massachusetts Institute of Technology from the National Science Foundation. The Instrument Society of America will handle subscriptions and circulation of the English translations. Annual subscription rates for 12 issues, starting with vol. 18, no. 1, are $30 to individuals in the United States and Canada; and $15 to libraries of academic and other nonprofit institutions. Single issues are $3.50.

Nuclear Energy

THE *Journal of Nuclear Energy* will, in the future, be published in two parts (A and B) dealing respectively with basic reactor science and reactor technology. Part A will continue to be published monthly with but little alteration. Part B will be published quarterly and will be devoted to technological subjects drawn from all scientific disciplines which contribute to the development of nuclear energy for peaceful purposes. Special features of Part B will be its international character, high scientific and professional standards, and short publication time.

Plastics

Kunststoffe, a leading European plastics technical journal, published in Munich, Germany, is making available English translations of outstanding papers and articles from foreign countries in the field of plastics science and engineering.

The usual German edition of *Kunststoffe* has been enlarged to include a supplement, "German Plastics Digest," which contains condensed English-language translations of the most important articles appearing in the journal every month.

Subscriptions for the expanded magazine are $32 annually, and should be sent to Carl Hanser, Zietschriftenverlag GMBH, Munich 27, Germany.

Proceedings

● "PROCEEDINGS of the International Congress of Combustion Engines" are now available. The 1957 Conference held in Zurich had as its subject supercharged diesel engines and combustion turbines in the spheres of marine, traction, and power stations. The volume contains the texts of lectures, technical papers, and discussions. Copies which cost approximately $15 may be obtained from the Swiss Association of Machinery Manufacturers, General Wille-Strasse 4, Zurich 27, Switzerland.

● "RECENT Advances in the Engineering Sciences," the Proceedings of the Conference on Science and Technology for Deans of Engineering, is now available. The conference surveyed the technical aspects and educational implications of several expanding areas related to engineering. Recognized authorities discussed automation, operations research, administrative problems, thermodynamics, nuclear engineering, and such. Published by the McGraw-Hill Book Company, Inc., the 257-page book costs $4.75.

● THE "Proceedings of the Computers in Control Systems Conference" held in Atlantic City, N. J., October 16–18, 1957, are now available. Published by the AIEE, sponsors of the conference with the IRE and ASME, the proceedings are priced at $3.50, and may be obtained from: AIEE Order Department, 33 West 39th Street, New York 18, N. Y.

● FULL technical details on significant developments in reinforced plastics in materials, processing, performance, and end uses, as presented to the 13th Conference of the Reinforced Plastics Division, are available in two volumes from the Society of the Plastics Industry, Inc., 250 Park Avenue, New York 17, N. Y., for $7 plus postage.

The Preprint book, 627-pages, contains texts and illustrations of the 72 talks presented at the reinforced plastics Technical and Management Conference. The second volume, on Proceedings, comprises a full report on questions and answers engendered at the 16 separate Conference sessions.

Plastics for buildings and boats; tooling of plastics; premix materials; performing and filament winding; high-temperature performance; and new materials are each treated in detail.

SPI will ship the Preprint book upon receipt of the order and will invoice at that time. The Proceedings volume will be shipped when it comes off the press.

● "TECHNIQUES of Plant Maintenance and Engineering—1958," the ninth volume in a series, reports the proceedings of the Plant Maintenance and Engineering Conference held in Chicago, January, 1958. The proceedings include texts of 35 papers, 450 questions and answers, an equal number of questions answered in the summary of nine round-table discussions, 42 charts, tables, and illustrations. Bound in cloth on board, with 211 pages, the volume is available from the publisher, Clapp & Poliak, Inc., 341 Madison Avenue, New York 17, N. Y., for $10 postpaid.

● "PROCEEDINGS of the Conference on Thermodynamic and Transport Properties of Fluids," which was held in London in July, 1957, will be published by The Institution of Mechanical Engineers during 1958.

The Conference was arranged jointly by the Institution and the International Union of Pure and Applied Chemistry.

The proceedings will include the full text of 30 papers with discussion and authors' replies, and a report on the opening session of the Conference. They will be fully indexed.

The price of the proceedings will be £2 15s 0d ($4.90) per volume, bound in linen buckram, or £2 10s 0d ($3.40) per volume, bound in card covers, both post free.

New Publications

"TRANSACTIONS of the Metallurgical Society of AIME" are now issued as a separate publication of the American Institute of Mining, Metallurgical, and Petroleum Engineers. To be published bimonthly, the new journal will include engineering and scientific papers of permanent interest for all three divisions of the Metallurgical Society of AIME. Subscriptions are available to AIME members for $5 per year; and to nonmembers, $20 per year.

Inventor's Guide

THREE experts in the fields of patents and invention have combined their talents and experience in preparing the "Inventor's Handbook," a guide both to the experienced inventor and to the novice who is involved in the intricacies of patent protection.

This new book now available from the Arco Publishing Company, 480 Lexington Avenue, New York 17, N.Y., for $2 tells the inventor how to protect his idea, then ventures into a previously uncovered field and shows how he can raise capital to get his invention into production.

Sections of "Inventor's Handbook" explain how to create a successful invention (and when to discard an idea), how to avoid court action on patents, how to protect a trade-mark or slogan. New and fertile fields for the would-be inventor are described in detail.

Welding Directory

THE 1958–1959 edition of The Welding Directory, complete reference guide to welding, cutting, brazing, plus auxiliary equipment and supplies, is now available.

Compiled and edited by the editors of *Industry & Welding* and *Welding Illustrated*, the 680-page directory lists more than 350 products, 1700 different trade

names, and more than 2000 welding distributors.

It is conveniently divided into five sections; first is a directory of welding, cutting, brazing, and auxiliary products.

Section 2—the Trade Names Index—presents a complete, up-to-date, alphabetical listing of all trade names, description of products, and names and locations of manufacturers.

The Manufacturers' Catalog Section, Section 3.

The Fourth Section is a reference manual containing welding, cutting, brazing, and application data.

The last section, "Where To Buy It Locally," is carefully indexed and geographically and alphabetically arranged for ease of reference.

Copies of The Welding Directory may be ordered at $6.50 each, from The Industrial Publishing Corporation, 812 Huron Road, Cleveland 15, Ohio.

Free Literature

A "List and Index of American Standards" has been published by the American Standards Association. This 67-page booklet lists the 1723 voluntary national standards approved by the ASA.

These standards were developed by national organizations concerned with standards formulation and working either under their own auspices or within the framework of the ASA.

Many thousands of experts served on the technical committees of these organizations and on the 225 national committees organized under ASA procedures.

There are in this edition 465 new and revised standards which were not listed in the 1956 edition. The publication also lists 44 international recommendations of the International Organization for Standardization (ISO) and 43 of the International Electrotechnical Commission (IEC). These are available in this country only from the American Standards Association, U. S. member of these organizations.

Free copies of the new "List and Index of American Standards" are available from Department DD-7, American Standards Association, 70 East 45th Street, New York 17, N.Y.

PEOPLE

New Appointments. T. KEITH GLENNAN, Cleveland educator and former member of the Atomic Energy Commission, has been named head of the National Aeronautics and Space Administration.

ALLAN BERNHARDT has been appointed editor of *Aero/Space Engineering*, published by the Institute of the Aeronautical Sciences, it was announced. Formerly associate editor, he succeeds WELMAN A. SHRADER, who will devote full time to duties as Director of all IAS publications.

ARTHUR H. WAYNICK has been appointed program director for Engineering Sciences, Division of Mathematical, Physical, and Engineering Sciences at the National Science Foundation.

JEROME W. WOOMER, Pittsburgh consultant, has been elected president of the Society of Mining Engineers, a constituent body of the American Institute of Mining, Metallurgical, and Petroleum Engineers. He will serve one year beginning February, 1959.

STEPHEN S. ATTWOOD has been appointed dean of The University of Michigan College of Engineering.

LEROY A. BROTHERS has been appointed dean of the College of Engineering of Drexel Institute of Technology. Dr. Brothers succeeds HARRY L. BOWMAN, who will continue as Dean of the Faculty.

MAX W. CARBON, Mem. ASME, thermodynamics expert who has been working recently on development of the ICBM nose cone for the U.S. guided missile program, was appointed today by University of Wisconsin regents to direct the University of Wisconsin's expanding Nuclear Engineering Program.

HAROLD A. BOLZ, Mem. ASME, has been appointed dean of Ohio State University's College of Engineering by the University's Board of Trustees. Associate dean of the engineering college since joining the Ohio State Staff in 1954, he was named acting dean last March when GORDON B. CARSON, Mem. ASME, former head of the college, was made the university's vice-president—business and finance.

LESTER V. COLWELL, Mem. ASME, professor of mechanical engineering, University of Wisconsin, has been granted leave for the 1958–1959 academic year to be visiting professor at the Technische Hochschule, Aachen, Germany. He will lecture on metal-cutting theory and supervise graduate students. He will also study the organization and operation of manufacturing research laboratories in Europe.

LLOYD M. TREFETHEN, who served as the first executive director of the National Science Board of the National Science Foundation, and a former assistant professor of mechanical engineering at Harvard University, has been appointed professor of mechanical engineering and chairman of the department at the Tufts University College of Engineering.

LEE ARNOLD, noted authority on aeronautics, has been named to fill two important posts at New York University's College of Engineering. He has been appointed professor and chairman of the department of aeronautical engineering, and director of the Daniel Guggenheim School of Aeronautics.

Retirement. HOWARD S. BEAN, Fellow ASME, chief of the Capacity, Density, and Fluid Meters Section of the National Bureau of Standards, retired July 1 after 41 years of continuous service with the Bureau. Formal recognitions of Mr. Bean's work include the Worcester Reed Warner Medal of The American Society of Mechanical Engineers, which he was awarded in 1955 for "his valuable contributions to the art and science of fluid metering and his unselfish work in preparing the many authoritative publications on this subject."

AWS Establishes Welding Information Center

AN Information Center has been established by the American Welding Society, 33 West 39th Street, New York City, for the dissemination of welding news and information.

The new Center will serve as an authoritative source for all information related to welding. This service will be of substantial benefit to both the press and industry. The press will be able to check with the Center for technical accuracy, verify news items, obtain additional facts and details to make a story or article complete, and, in many instances, obtain photographs to illustrate material.

Thirteen Engineers Visit Russia to Inspect Automatic Factories

ASME-initiated tour, part of technical exchange program

A 13-MAN study team of engineers left for Moscow, August 16, to inspect Russian automatic factories and research institutes engaged in the field of automatic control devices and development.

They visited plants in Moscow, Leningrad, and L'vov as well as the Central Technical Institute, Moscow, a leading center of Soviet Research and Development in Automatic Control. The group, sponsored by American Automatic Control Council and The American Society of Mechanical Engineers, represented, in addition, professional divisions of the American Institute of Electrical Engineers, American Institute of Chemical Engineers, Institute of Radio Engineers, and the Instrument Society of America. Delegates included some of the nation's leading experts in the field of automatic control.

The delegation made the trip at the invitation of the USSR Academy of Sciences and the Government Learned Technical Committee, representing 12 Russian engineering societies. The tour, initiated by ASME, was part of the technical exchange program agreed upon by the U. S. and Russian governments.

The delegation, under the leadership of William E. Vannah, Mem. ASME, editor of *Control Engineering*, McGraw-Hill publication, will report its findings to the U. S. engineering community at a series of professional meetings.

On his return trip, Mr. Vannah addressed the Norwegian Institute of Technology and compared control technology in Russia and the United States.

Other members of the delegation included: J. H. Felker, manager of special systems engineering, Bell Telephone Labs, New York; Herbert Ziebolz, assistant vice-president of engineering, General Precision Equipment, New York; George Newton, professor of electrical engineering, Massachusetts Institute of Technology; Philip Sprague, president, Hays Corporation, Michigan City, Ind.; and Harry W. Mergler, professor of mechanical engineering, Case Institute of Technology, Cleveland.

Some of the members of the 13-man team of engineers are shown just before take-off for Russia, August 16, to inspect automatic factories

Also, S. W. Herwald, manager, Air Arm Division, Westinghouse Electric Corporation, Baltimore; E. M. Grabbe, senior scientist, Computers Systems Division, Thompson-Ramo-Wooldridge, Los Angeles; E. P. Epler, head of reactor controls, Oak Ridge National Laboratory; R. J. Kochenburger, head of electrical engineering department, University of Connecticut; N. Cohn, manager of market planning, Leeds & Northrup Company, Philadelphia; Ralph Palmer, chief engineer, Data Processing Division, IBM, White Plains, New York; and Edward J. Kelly, research engineer, Lincoln Laboratory, M.I.T.

Members of the delegation have reported on what they have seen at open meetings of the Instrument Society of America at Philadelphia, in September, and will discuss their report at the 1958 Annual Meeting of The American Society of Mechanical Engineers. Reports will also be published in American technical publications.

Battelle President Thomas Urges Scientists to Act in Human Affairs

DETACHMENT from human affairs is a luxury that scientists can no longer afford, so says Dr. B. D. Thomas, president of Battelle Memorial Institute, Columbus, Ohio, in an article outlining the position of the scientist in contemporary society. Writing in the September issue of the *Battelle Technical Review*, he reminds his fellow scientists that "the technical man has been drawn into the stream of human events by the circumstances of the last two decades in such a way that he has become the custodian of much of civilization."

The research administrator says of scientists: "We have often kept ourselves aloof from those human matters where logic and objectivity seem to have little part and where prejudice and circumstance seem to be in control. We have been content to stand by and see decisions made affecting the lives of all of us, made sometimes by men with no real knowledge of what they were doing or concern for the consequences of their action. The time for this detachment has passed."

Man Is Threatened

"There are men on earth today," the Battelle executive points out, "who know all that is needed to be known to build a space ship to take us to the moon or the planets. There are also men," he warns, "who know all that is needed to be known to make the earth uninhabitable by human beings."

In taking a more active part in human affairs, Dr. Thomas says that scientists must overcome the "disdain" in which they are often held in the public mind. "Even those who are very willing to accept the material benefits derived from applications of science," he writes, "are often quick to suspect and condemn the source. . . We can note an anti-intellectualism in the so-called 'common man.' "

Action for Scientists

Describing a philosophy of action for scientists, Dr. Thomas discusses three important points:

"First, if we are to be the interpreters of science to the rest of mankind, we must understand and respect our science. We must recognize our part—our responsibility as the custodian at this particular moment of that legacy of knowledge that we have received from the past and that we are duty-bound to pass on to others. We must remember, as Spencer says, that we are descendants of the past, and parents of the future."

A second point in a scientist's philosophy is "concerned with the fact that as human beings we cannot afford to look with disinterest on anything that degrades our fellow man. . . We can afford to be patient with the social experimentation that seems to be going on in the world today. But we must not ignore the interest of our fellow man. It is a good criterion to use, for instance, in the field of education. The essential difficulty with our education today is that it is directed toward mediocrity. Through a misguided attempt to serve the democratic principle of equal rights for all, we have merely succeeded in reducing educational standards to the near-vanishing point. Because we know and understand something about the need for educated men and women in the world today, we must accept the responsibility for doing something about this problem."

The final point advanced by the Battelle scientist is that "the scientist must always be concerned with the rights of the individual." "Science," he says, "for all that it is completely democratic, is essentially the concern of the individual." The ideal of freedom should be part of the personal philosophy of every scientist and engineer, according to Dr. Thomas. "Some may say that it should be part of the personal philosophy of every American, which is, of course, true. But it applies even more to scientists. . .Unfortunately, there is abundant evidence that many Americans, perhaps the majority, do not appreciate or understand the personal freedom they enjoy."

Dr. Thomas concludes that "scientists have great responsibilities in guarding our civilization. They must take a larger part in holding standards high, not only in science and technology, but in every facet of life."

Research and Development Budget Grows

BUDGETED expenditures for research and development in 1958 are up an average of 4 per cent over 1957, according to a survey released by the American Management Association. More than 800 companies took part in the study.

Results of the survey were disclosed at an AMA seminar on planning for growth.

Of the 24 industries covered in the survey 18 showed an increase in budget for R&D ranging from 2 per cent to 26 per cent (transportation equipment). Six industries showed a decline in budget; the greatest reduction was 15 per cent (construction machinery).

Other industries showed marked increases in their budgets for research and development. Those with the greatest reductions in budgeted expenditures were: engines and turbines (9 per cent) and autos (6 per cent).

Research and development expenditures in 1957 averaged 2.8 per cent of 1957 sales, the survey showed. Industries reporting the highest percentages were instruments (5.2 per cent), autos (5 per cent), electrical machinery (4.8 per cent), and aircraft (4.4 per cent).

An analysis of the figures indicates that: (1) In most cases budgets are still tied to near-term expectations; (2) an attempt is being made to offset cutbacks by exercising greater selectivity in choice of projects and through operating economies; and (3) the emphasis is on the development of items that are "close to the shipping-room door."

1958 Research and Development Budget Analysis

Industry group	Companies reporting	1958 Budget % of 1957 Budget Up	Same	Down	Average	1957 Budget % of 1957 sales
Agricultural Machinery	5	2	3	0	3.4	1.3
Aircraft	20	7	8	5	3.8	4.4
Autos	7	3	2	2	−6.0	5.0
Chemicals	209	131	67	11	10.0	3.3
Construction Machinery	9	2	5	2	−15.0	1.5
Electrical Machinery	62	23	20	19	4.0	4.8
Engines and Turbines	15	4	1	10	−9.0	4.0
Fabricated Metal Products	68	23	21	24	0.5	2.1
Food and Beverages	69	41	21	7	8.3	1.2
General Industrial Machinery	33	12	12	9	2.2	2.9
Instruments	73	24	34	15	1.0	5.2
Metalworking Machinery	5	2	1	2	2.2	2.1
Miscellaneous Machinery and Parts	22	5	10	7	−3.1	2.4
Miscellaneous Manufacturing	58	15	24	19	−2.0	2.2
Nonferrous Metals	19	7	6	6	0.2	2.0
Office Machinery	18	10	3	5	5.2	3.2
Paper	30	16	8	6	5.0	1.0
Petroleum Refining	18	8	8	2	2.4	1.0
Rubber	16	7	3	6	−2.6	2.8
Service Machinery	4	4	0	0	13.3	1.7
Steel	16	7	6	3	4.0	1.0
Stone, Clay, and Glass	41	30	6	5	7.1	1.9
Textiles	2	1	1	0	2.5	2.2
Transportation Equipment (other than autos and aircraft)	14	6	5	3	26.0	1.8
Totals	833	390	275	168	Avg 4.0	Avg 2.8

Solar Energy

JOINT and separate programs for research, development, and practical application of solar energy to be carried out at the Princeton, N. J., division of Curtiss-Wright were recently announced by the Curtiss-Wright Corporation and New York University.

The programs will be under the direction of an internationally known solar scientist, Dr. Maria Telkes. She is recognized as an authority on solar radiation and has been in charge of solar-energy experiments at NYU since 1953. For 14 years prior to that she worked on solar energy at M.I.T.

The announcement of the new broad-scale projects was made by Roy T. Hurley, chairman and president of Curtiss-Wright, and Dr. John R. Ragazzini, dean of the NYU College of Engineering.

A complete sun court and solar laboratory recently completed includes a solar-heated house and a solar-heated swimming pool, solar furnaces, solar batteries, solar stills, solar driers, solar cooling equipment, solar radios, and solar food-processing equipment.

United Engineering Center

. . . Campaign facts and figures
. . . Current building studies

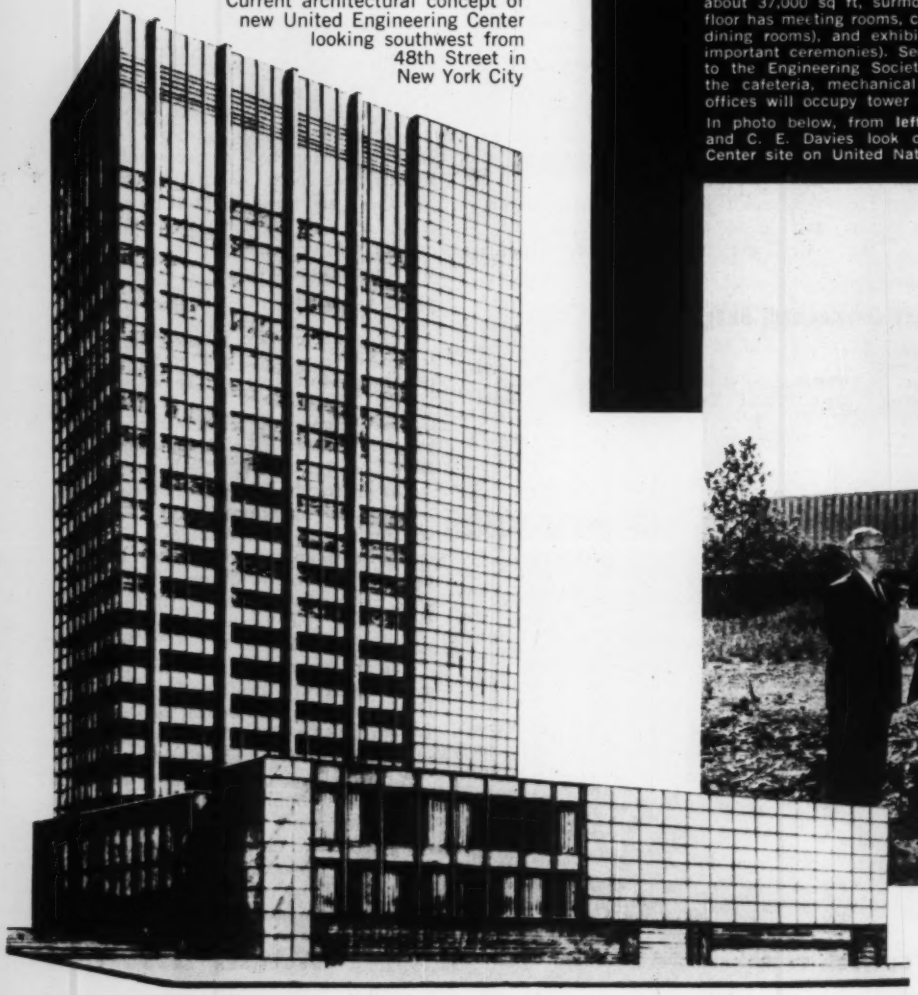
The Goal

Cost of the New United Engineering Center will be about $10 million, including the cost of the site—opposite United Nations Plaza in New York City—which has already been purchased.

Of this sum, $2 million will be obtained from United Engineering Trustees funds available for real-estate purposes and from the sale of the existing property at 29–33 West 39th Street, New York City. The remaining $8 million is the goal set to be raised by contributions from industry, and from voluntary contributions from the members of the various engi-

The Building

Current architectural concept of new United Engineering Center looking southwest from 48th Street in New York City



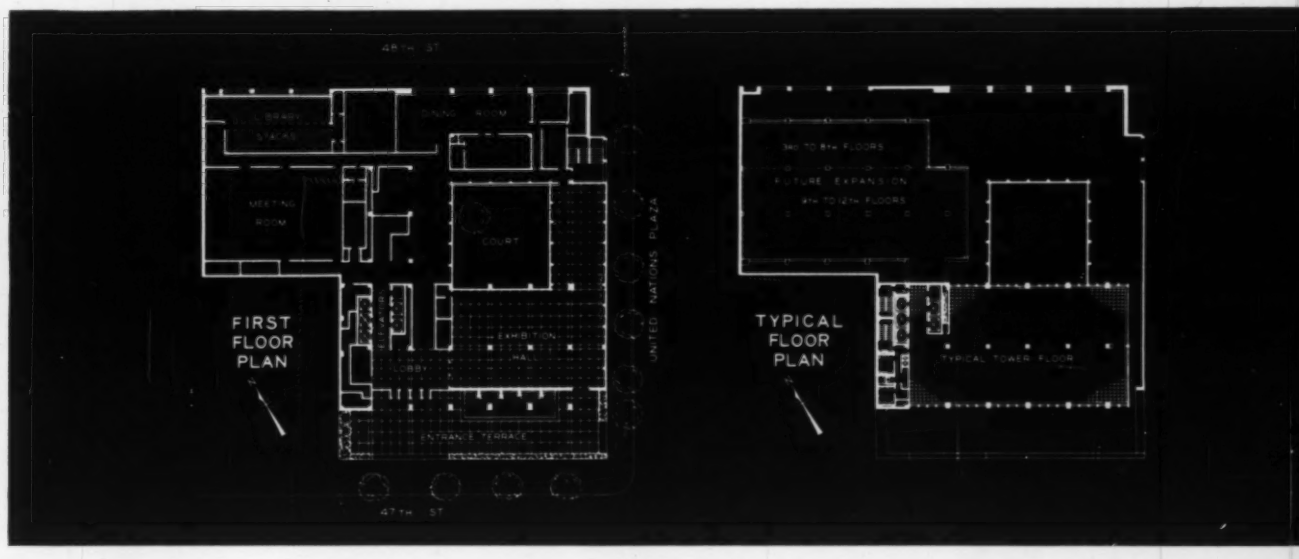
Current status of preliminary architectural studies of the new center. Sketch at **left** shows two stories covering entire site, about 37,000 sq ft, surmounted by an 18-story tower. First floor has meeting rooms, conference rooms (usable as private dining rooms), and exhibit space (usable for meetings and important ceremonies). Second floor will be devoted largely to the Engineering Societies Library. Basement will house the cafeteria, mechanical equipment, and storage. Society offices will occupy tower floors shown in sketch at **right.**

In photo below, from **left:** Walter J. Barrett, C. H. Linder, and C. E. Davies look over plans at United Engineering Center site on United Nations Plaza.

neering societies which will occupy the new building.

The industry quota is $5 million, and considerable progress has been made in reaching this goal. As of Nov. 7, 1958, nearly $3,750,000 has been subscribed.

The remaining $3 million is to be raised by the participating Societies, with quotas allocated on a membership basis. The quota accepted by ASME is $800,000, 8 per cent of the estimated cost of the Center. Quotas of the other Founder Societies are as follows: AIME, $500,000; ASCE, $800,000; AIEE, $900,000; AIChE, $300,000.



The Member Gifts Campaign

After a rather slow start the Member Gifts Campaign has, in recent weeks, picked up speed. As of Nov. 7, 1958, member gifts totaled over $1 million or about one third of the quota. With only a short time remaining before the campaign ends, there is still nearly $2 million to be subscribed or two thirds of the quota. There is much to be done.

Engineers, perhaps, have not yet fully realized what a United Engineering Center means to them. But an editorial in the *Engineering News-Record*, Oct. 30, 1958, pinpointed the benefits to engineers of such a Center and why they should support it. The *Engineering News-Record* said in part:

"Although the results so far are encouraging (of the Member Gifts Campaign), there remains a haunting doubt that engineers have yet sensed the importance of the outcome to themselves personally. For how well and how universally they support this United Engineering Center financing will be used by the world at large to measure how much pride U. S. engineers have in their profession. The prestige of engineering will go up or down according to the results, which cannot fail to affect the economic status and community standing of every engineer. The campaign for a new headquarters of engineering is thus not just another fund-raising drive, but a challenge to engineers to stand up and be counted.

"The pride and prestige that immediate financial support will insure will be enhanced for many years to come by the building itself. It will occupy a block-long site facing New York's United Nations Plaza—a world center attracting thousands of visitors every day. To them, the building's 20-story tower will symbolize engineer's importance. And inasmuch as the building will house not only the five societies that own it, but sixteen other engineering societies and organizations, it will also symbolize and promote the cause of unity in the profession, another prestige raiser.

"These pride and prestige factors are in addition to the very tangible contribution that the building will make in improving operating efficiency of the engineering headquarters staffs.

"If engineering is more than a casual occupation—and statements to the contrary are seldom voiced—the new United Engineering Center, financed in substantial part by engineers themselves, will lend these claims real substance. Conversely, failure to support it can readily be taken by the world at large as an indication that engineers do not place as much stock in themselves and their profession as their frequent assertions would seem to imply."

The ASME Member Gifts Campaign

The Nov. 7, 1958, Member Gifts Campaign status report reveals that percentagewise ASME stands fourth in relation to the five Founder Societies in dollars subscribed. So far only 3133 members have pledged $202,374 toward the project.

Although some Sections are nearing their quota or have even gone above it, a much larger number are far below the mark or haven't even reported at all. This is revealed by the accompanying progress report by ASME Sections which shows the variation of results. It clearly

indicates in many instances what can be done by groups of dedicated member-workers in an ASME Section. Those Sections which have exceeded their quotas are continuing to contact members so that everyone has an opportunity to give.

The graph reveals that AIEE has greatly increased their rate of member-giving with the result that 7390 AIEE members have pledged $325,443 or 36.2 per cent of their quota.

Since AIEE is using a field organization identical with that established by ASME, it is evident that we can overtake AIEE only by accelerating direct contacts with the membership.

The ASME Member Gifts Campaign, therefore, must get into high gear now if it is to reach its goal of $800,000.

Tax Structure

For members concerned about contributing to the building fund—here is the answer to the question of tax refunds.

"Contributions made to you are deductible by the donors in computing their taxable net income in the manner and to the extent provided by Section 170 (*b*) (1) and (2) of the 1954 code."—Letter from U. S. Treasury Department, Internal Revenue Service, to United Engineering Trustees, Inc., and mailed to them at 29 West 39th Street, New York 18, N. Y.

CAMPAIGN STATUS

	Quota	Subscriptions	Number of Subscribers	Per Cent of Quota
ASCE	$800,000	$170,442	1792	21.3
AIME	500,000	135,605	1063	27.1
ASME	800,000	202,374	3133	25.3
AIEE	900,000	325,443	7390	36.2
AIChE	300,000	154,798	2375	51.6
Other	——	54,190	117	—
Total Member Gifts	**1,012,852**	**15,850**		**33.7**

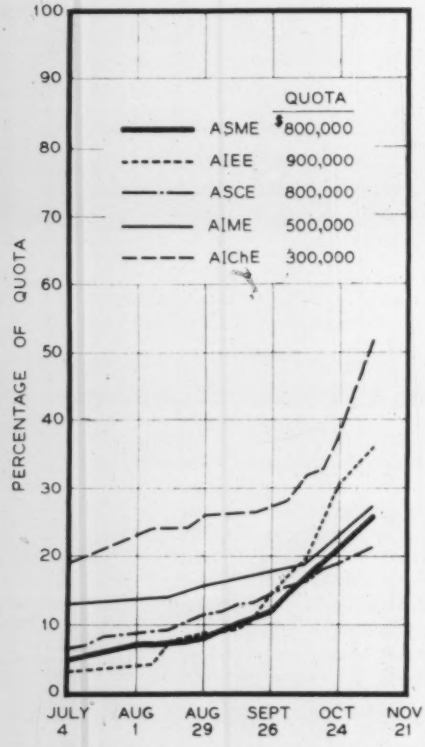
As reported on November 7

THE ASME MEMBER

Gifts Campaign

Section exceeds quota. At left, E. L. Robinson, right, Robert Plunkett, chairman, Hudson-Mohawk Member Gifts Committee.

WEEKLY PROGRESS



THE SCORE BY SECTIONS

	PER CENT PLEDGED of Members	of Quota
REGION I	5.7	21.0
Boston	3.4	10.0
Fairfield County	7.2	27.3
No. New England	0.4	0.5
Hartford	0.7	17.5
New Haven	1.3	13.0
New London	3.4	4.4
Providence	10.0	41.4
WATERBURY	**26.7**	**144.2**
Western Mass.	13.3	14.9
Worcester	14.4	21.9
REGION II	5.8	25.0
Mid-Jersey	8.3	18.2
Metropolitan	5.0	25.9
Mid-Hudson	17.0	26.6
REGION III	8.1	20.7
Anthra-Lehigh	9.3	27.1
Baltimore	19.6	44.0
Buffalo	0.8	2.6
Central Pa.	9.5	14.7
So. Tier	24.3	48.9
Philadelphia	0.6	4.3
Rochester	1.1	2.9
HUDSON-MOHAWK	**38.0**	**100.6**
Susquehanna	—	—
Syracuse	8.1	28.4
Wash., D. C.	1.1	2.8
Delaware	0.8	1.1
Olean	0.9	0.5
REGION IV	6.9	21.1
ATLANTA	**11.1**	**108.6**
Birmingham	19.6	43.1
Pied-Carolina	5.0	4.9
E. Tennessee	3.5	4.5
Florida	—	—
Greenville	—	—
E. No. Carolina	—	—
Savannah	5.3	11.2
Virginia	0.2	0.1
Chattanooga	—	—
Miami	0.7	0.4
Central Savannah River Area	—	—
N. W. Florida	46.5	89.6
REGION V	11.0	34.0
Akron	0.3	0.7
CINCINNATI	**35.8**	**120.7**
Cleveland	0.2	0.8
Columbus	13.0	28.0
DAYTON	**15.9**	**107.4**
Detroit	4.6	14.8
Erie	22.5	40.8
Ontario	0.2	0.2
Pittsburgh	6.4	20.7
Toledo	1.3	4.4
W. Virginia	47.6	92.8
Youngstown	—	—
CANTON-ALLIANCE-MASSILLON	**37.2**	**111.8**
Westmoreland	0.6	1.9
REGION VI	8.4	23.2
Cen. Indiana	5.3	29.3
Chicago	4.6	17.0
Fort Wayne	25.2	53.4
Louisville	5.1	11.2
Milwaukee	6.7	25.0
Minnesota	17.9	39.5
Nebraska	34.3	50.0
Cen. Illinois	21.4	36.8
Rock River Valley	6.7	21.1
St. Joseph Valley	3.2	6.6
St. Louis	8.9	15.0
Iowa-Illinois	0.5	0.6
Cen. Iowa	14.7	61.9
REGION VII	5.5	10.7
Inland Empire	15.2	24.7
Los Angeles	1.4	2.7
San Diego	11.8	16.5
Hawaii	18.0	40.5
Oregon	8.0	6.2
San Francisco	5.7	11.5
Utah	6.6	18.9
West. Washington	11.6	29.1
Arizona	19.3	32.2
Columbia Basin	0.8	0.8
REGION VIII	2.8	7.0
Rocky Mt.	9.8	14.9
Kansas City	0.6	12.2
Mid-Continent	1.1	2.2
New Mexico	11.6	27.7
New Orleans	2.9	7.0
North Texas	0.2	0.8
Sabine	5.0	17.3
South Texas	1.0	0.7
Mexico	—	—
Central Kansas	—	—

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

ASME Heat Transfer Division Symposium on Thermal Properties at Purdue, Feb. 23–26, 1959

Technical program to be presented in nine sessions lists 46 papers by leaders in the thermal properties research field. Special symposium volume planned.

THE third Symposium on Thermal Properties of Gases, Liquids, and Solids, sponsored by the Heat Transfer Division of The American Society of Mechanical Engineers, will be held at Purdue University, Lafayette, Ind., Feb. 23–26, 1959.

The symposium is being presented in co-operation with the Central Indiana Section and the Purdue University Thermophysical Properties Research Center with Prof. Y. S. Touloukian of Purdue serving as Symposium General Chairman.

For many years the standing committee on Thermophysical Properties of the Heat Transfer Division has been active in encouraging original research on thermal properties within, as well as outside of ASME, and has endeavored to keep abreast of activities in this area to promote broader dissemination of scientific and technical information. Among the various activities of this committee, perhaps the most important one has been the sponsorship of symposiums on thermal properties of matter. The symposiums were held in the past during ASME Annual Meetings, December, 1947, and December, 1953.

During the past two symposiums special emphasis was given to the thermal properties of gases. In recent years interest in the thermal properties of liquids and solids has increased considerably. Therefore it was decided that the committee solicit papers in the broad area of both transport and thermodynamic properties of gases, liquids, and solids.

Technical Sessions

Forty-six papers will be presented at the symposium. These papers are grouped into nine sessions constituting specific areas within the broad field of thermal properties research. It is the intent of the committee that these papers will be published as a group in a special symposium volume which will be available at the opening session of the symposium.

Aim of Symposium

As in the case of the previous two symposiums, the third is designed to assist two groups of scientists and engineers; namely, those who are responsible for the generation of information on thermal properties and those who are the users of this information. Sessions 1 and 2, devoted to transport properties, not only survey the present status of the theoretical and experimental state of the science, but also indicate the wide gaps and paucity of knowledge existing in both transport and thermodynamic properties, particularly at high temperature and at high or even moderate pressures. It is conceded that the present knowledge of transport properties is in general at least two orders of magnitude behind the present state of knowledge of thermodynamic properties. Perhaps the most serious bottleneck in present and future technological advances lies in the inadequate knowledge of the properties of matter of which the thermal properties constitute a major segment.

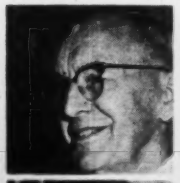
The papers listed in sessions 3 through 9, dealing with gas and liquids, equation of state, boron compounds, transport properties of metal and ceramics, and gases, report an appreciable amount of new data and several of them summarize and review the state of the knowledge in specific areas covered by the papers. The symposium proposes to serve its main purpose of pointing out the areas of strength as well as weaknesses in the knowledge of thermal properties, and will stimulate much accelerated research in this most important field.

(See page 131 for the technical program in detail.)

Memorial Center and Purdue Union Club at Purdue University where ASME Heat Transfer Division Symposium on Thermal Properties will be held, Feb. 23–26, 1959

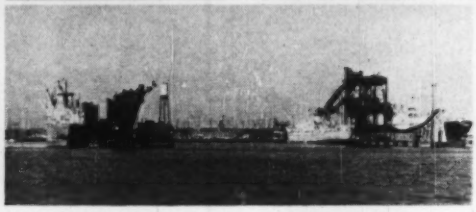
Name, please? In this case, it's Trinks, Dr. Willibald Trinks, engineer, author, teacher, and Fellow of the ASME

Williams: "I present this Fellowship Award. . ."



Hutchinson: "We exported 60 million tons. . ."

Engineers and their ladies board the Cherokee to cruise Hampton Roads



Swing of the famous harbor took the Conference past the coal-loading piers of Norfolk where much of America's export coal is loaded

ASME President J. N. Landis presides at the Conference banquet

ASME and AIME in Solid Fuels Conference at Virginia Resort

At Old Point Comfort, Va., on the historic approaches to Jamestown, the Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining, Metallurgical, and Petroleum Engineers held their twenty-first Annual Joint Conference, Oct. 8–10, 1958.

The conference's theme was "The Export Coal Market." Thus it was fitting that the gathering be held practically within sight of the great piers of Norfolk and Newport News. The U. S. exported 60 million tons in 1957, and most of it took ship at the mouth of the James River.

Significant in another way to the more than 200 engineers assembled at Old Point Comfort was the honoring of a senior member of their fraternity. Dr. Willibald Trinks, who joined the ASME in 1905, and who has been a Fellow of the Society since 1948, received the Percy Nichols Award for 1958. Dr. Trinks, who was introduced as "83.83 years of age," is a consulting engineer and former head of the Department of Mechanical Engineering at Carnegie Tech. These facts give only the slightest hint of his tremendous service to the practice and teaching of engineering. It has been said that the combustion of coal is a matter of Time, Temperature, Turbulence, and Trinks.

The Chamberlin, the resort hotel which housed the conference, stands in lone civilian grandeur on a point of land otherwise occupied by the lower buildings of the U. S. Continental Army Command. Thus it was that engineers attending the Friday morning technical session paused in their contemplation of bulk-solid flow while a 19-gun salute was fired in honor of a visiting Spanish general. (There would be 21 guns for a president or king.)

Where History Was Made

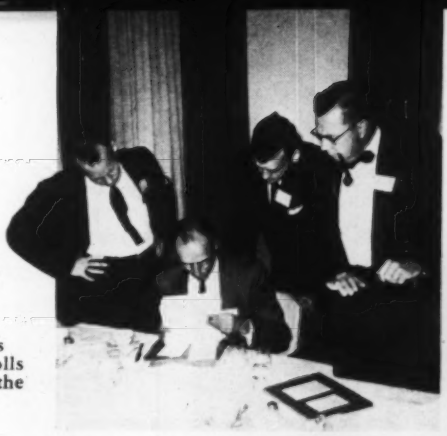
Newport News got its curious name from a Captain Christopher Newport who sent news of the Jamestown Colony to England. The records of the Virginia Company of London placed settlers "along the bankes of the great river between Kequotan and Newportes Newes" in 1619. It became a tobacco port (another solid fuel), and in 1880 it was chosen as the Atlantic deep-water coal-shipping terminal for the Chesapeake and Ohio Railway system.

The ground on which the Chamberlin stands is not far from the landing place of the London Company's first party of settlers. They stopped at Old Point Comfort immediately after their Cape Henry arrival in 1607, and went on to Jamestown. Historically, no tonnage of coal shipped and no fabulous ships built at Newport News can outshine the fact that this was where the English-speaking American nation began.

While the conference theme of foreign trade seemed remote from the technical interests of the ASME, the fact is that every paper presented at the technical sessions held meaning for mechanical engineers. Whether a member of the ASME described a pneumatic system for conveying coal 270 ft from storage to boiler plant (partly underground, to avoid trackage, cranes, and buildings), or AIME men discussed the conversion of a boiler installation from hard to soft coal (to reduce steam costs), this was mechanical engineering.

A paper of unusual interest reported the use of "delayed coke," a refinery by-product with limited market because of high sulfur content, as a combination fuel with coal. An agreement between a utility and a refinery resulted in a market for this by-product fuel plus all-electric operation of the refinery. The paper described the handing problems and the performance. Substantial savings resulted for both companies.

Due to fog, a number of engineers who had intended to be on deck for the morning of Thursday, Oct. 9, were, instead, having their fill of the Washington airport. James N. Landis, President of the ASME, was among those delayed. One of our Society's past-presidents, Eugene W. O'Brien, stepped into the breach and represented the ASME, both at the authors' breakfast and at the Luncheon.



Authors' breakfast. "It says here, in the Chairman's folder. . .."

Mr. and Mrs. Trinks and the Percy Nicholls Award presented to the famed engineer by E. R. Kaiser

Ritchie of AIME presides at luncheon

Technical session: L. E. Mytling presents a paper

Above, left to right: J. C. McCabe, G. E. Keller, Dr. Livingston (who delivered the invocation), G. G. Ritchie, E. E. Williams, and J. N. Landis. *Below, left to right:* C. S. Reed, J. E. Tobey, E. R. Kaiser, W. Trinks, C. S. Dennis, and E. W. O'Brien.

Registrations top 240 as mechanicals and miners meet in 21st Joint Annual Conference. Cruise of Hampton Roads shows coal-loading piers.

At this luncheon, speaker S. P. Hutchinson, executive vice-president of the General Coal Company, Philadelphia, Pa., briefed the conference on the export-coal situation. Today, our coal is shipped to more than 40 countries, the greatest tonnage going to Germany, Holland, Italy, France, and Japan, in that order. Western Europe has ceased to be self-sufficient, since England no longer has a surplus.

Mr. Hutchinson traced the overseas flow of bituminous coal from the war years to the present, the demand reflecting foreign energy requirements. In 1957 we exported 60 million tons, and in 1958, 40 million. Competition coal comes from Poland, Russia, and Australia.

Over the Bounding Main

The Joint Solid Fuels Conference set a happy precedent when, at the hotel's pier, it boarded the cutter *Cherokee* as guest of the Coast Guard and cruised the history-laden waters of Hampton Roads. For three hours, Thursday afternoon, some 200 conferees and their families sailed along the coal-loading piers and the shipyards of Norfolk and Newport News, crossing the famous naval anchorage.

The 1700-ton *Cherokee*, a seagoing fleet tug, is the primary search-and-rescue vessel of the 5th Coast Guard District, ready at all times to head for the scene of any maritime disaster. Her length is 205 ft, her four diesels total 3040 hp, and she is equipped with every device for heavy-weather rescue work. The crew's mess room contains a television set which became an important consideration on this Thursday afternoon, since the final game of the world's series was being staged concurrently with the cruise. While the contest in Milwaukee was at its height, the *Cherokee* ploughed the waters where an earlier contest had been fought, that between the *Monitor* and the *Merrimac*.

Three and a half centuries of American history awaited the ladies—more than fifty of them—who accompanied their husbands to the conference. They toured the Jefferson Davis casemate (the chamber where the Confederate President was confined) at Fort Monroe. On Friday, the ladies went by bus to the restored Colonial city of Williamsburg, halfway between Old Point Comfort and Richmond. They spent the entire day there, lunching at the Old Williamsburg Lodge.

"Judgment Day"

The seagoing adventure was not the only innovation in this lively and surprising conference. For the banquet, the committee had arranged an interlude of choral singing by a negro group called "The Crusaders." They were workers from the shipyards, from nearby Langley Field, from Fort Monroe. They sang songs such as "Judgement Day," "Don't Scandalize My Name," and "Shine on Harvest Moon," and they stopped the show. It took grand old Willibald ("Willie") Trinks to bring the evening back to engineering.

ASME President Landis presided at the banquet. Like many others, he was struck by an observation made by Dr. Trinks, that "Brainwork, once done, should not be done over again, except for education." This is clearly the basic purpose of the ASME in its Meetings and Conferences—to place brainwork on permanent record so that repetition can be avoided and the profession go forward more rapidly. Mr. Landis commented on the selfless quality of Dr. Trinks' long service to mechanical engineering, the financial sacrifices made by a man who elects to serve as an educator.

J. C. McCabe, Chairman of the Executive Committee of the ASME's Fuels Division and editor of *Combustion*, spoke in tribute to the men on the many committees who put this excellent conference together, and to the many companies whose support made it possible. The actual presentation of the award to Dr. Trinks was made by E. R. Kaiser of the ASME's Fuels Research Committee and Senior Research Scientist of NYU, who gave a glowing account of the career and personality of this outstanding engineer.

Pre-banquet gathering. ASME and AIME brought together 200 solid-fuels engineers.

Baumeister: "In our time, the northwest passage"

Reed: ". . .the best labor market in the country"

The award is an annual one, made by these two divisions of the ASME and the AIME.

The Percy Nicholls Award

Dr. Trinks was honored "for notable scientific and industrial achievement in the field of solid fuels." Author of many books and technical papers, he has been a guiding factor in the improved technology of the utilization of coal, coke, and gas in coke ovens, blast furnaces, gas producers, and industrial furnaces. He has been teacher to more than 1500 mechanical engineers, and consultant to industry and government.

Five past recipients of the award were present, this year, to see Dr. Trinks honored.

Dr. Trinks was born in Germany and came to this country in 1898. In Germany, he had known Rudolph Diesel. In his speech at the banquet, he mentioned that Diesel had wanted to run his engines on pulverized coal, but had encountered failure, partly because cylinder walls and piston rings could not endure the ash.

"The solid-fuel engineer," Dr. Trinks said, "must be a slag engineer and a clinker engineer. It is my dream to discover a way to take the ash out of coal before it is burned instead of after. Someday we may succeed in doing this."

(At the ASME's Annual Meeting, which starts just as this edition of MECHANICAL ENGINEERING appears, the Gas-Turbine-Power Progress Report will tell of tests on coal-fired gas turbines for locomotives.)

In 1905, the young engineer from Germany decided that he must serve as a teacher as well as a practicing engineer, and he joined the faculty of Carnegie Tech where, for 38 years, he was chairman of the Department of Mechanical Engineering. A number of his former pupils were present at the conference.

Guest speaker C. S. Reed, vice-president of Duke Power Company, offered an analysis of market potential and labor potential in relation to population densities. His point: It is the density per square mile, not the state density (which may be packed into cities) which determines the health of a state's growth. Mr. Reed is partial to the Piedmont (North Carolina) area, and his figures make a strong case for this area's potential.

Fellows of the ASME

At Friday's luncheon, two members of the ASME received certificates making them Fellows of the Society. They were: Prof. James B. Jones, head of the Mechanical Engineering Department of Virginia Polytechnic Institute, Blacksburg, Va.; and Prof. Theodore Baumeister, of the Mechanical Engineering Department at Columbia University, New York, N. Y. Arthur Roberts, Jr., Chief Engineer of the Lynchburg Foundry Company, Lynchburg, Va., and a former Vice-President of the ASME's Region IV, made the presentation to Professor Jones. E. E. Williams of Duke Power and General Committee Chairman for the conference made the presentation to Professor Baumeister.

Professor Baumeister delivered the main address, speaking on "Atomic Power and Solid Fuels." He proposed that we adopt restraint in our predictions of the displacement of solid fuels by fission heat. He reminded his audience that the atomic picture is confused because of the many interests—military, political, economic—each with its individual compulsion.

For the military, atomic power plants can do what no other power source can do at any price.

"The atomic power plant," he said, "is the only way we know to sail the Northwest Passage (under the polar ice). We can offer no alternative. For an effective navy which will successfully defend the realm, we have no choice except to build atomic propulsion plants and to push them to the limit of their technological potential."

The lessons learned from these naval reactor power plants will be carried over into many other fields. But Professor Baumeister warned that every atomic utility plant so far has run to far higher costs than anticipated. And fission fuels may not be in such large supply as has been thought.

What Price Atomic Fission?

He stated: "It has been said that one kwhr is needed to make the U-235 which will later, when used in a reactor power plant, deliver two kwhr. This is like saying we have a conventional steam plant with 33 per cent auxiliary power use. Compare that with the power required to dig coal from the ground and deliver it, pulverized, to a boiler furnace—a couple of per cent, not 33 per cent. Such a figure implies a very high cost for nuclear fuel.

"The coal industry will not stand still....Aggressive technological and economic competition will demonstrate the markets which rightfully belong to fission fuels, and those which belong to fossil fuels."

Availability List: ASME-AIME Joint Solid Fuels Conference

THE papers in this list are available in separate copy form until August 1, 1959. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers.

58—Fu-1 Utility Boiler Fired With Delayed Coke and Coal, by S. C. BROWN, JR.

58—Fu-2 Design Considerations for Pneumatic Coal-Handling System, by WALTER GRUCA

58—Fu-3 First Cyclone Furnace Boiler in Southeast, by W. BROSS

ASME-EIC Engineering Education Conference at University of Michigan, Oct. 15-16, 1958

"How Should Industry Aid Engineering Education?" was the topic discussed by more than 100 invited members of the Engineering Institute of Canada and The American Society of Mechanical Engineers as they convened for two days, Oct. 15–16, 1958, on the campus of the University of Michigan, Ann Arbor, Mich. This was the third of a series of biennial, joint meetings inaugurated in 1954 with sessions at Clarkson College of Technology, and again, in 1956, at the University of Western Ontario.

Industry's Stake in Engineering Education

Not "Should" or "Why"—but "How"—was the positive attitude exhibited by the program participants and conferees as industry's stake in the realm of engineering education was probed in three related symposiums and by appropriate comments in a well-conceived schedule of other events.

From the moment of significant introductory remarks by E. W. Allardt, Vice-President, ASME Region V, who represented J. N. Landis, ASME President, to the final speech by Kenneth F. Tupper, EIC president—it was evident that those on the program (approximately half from each of the two countries) were qualified uniquely to present telling points of view. As a consequence the conference was marked by spirited discussions of the many-faceted theme.

The first session was moderated by Richard G. Folsom, Fellow ASME, president of Rensselaer Polytechnic Institute. His panelists set the tone of the whole meeting by addressing their thoughts to the basic consideration—"The Philosophy of Co-operation Between Industry and Higher Education." Ira G. Needles, chairman of the board of the B. F. Goodrich Rubber Company of Canada ably developed his personal idealism which has resulted from a lifetime in industry—and more recently in the last few years, by his profound interest in the conception of a Co-operative Engineering Course at Waterloo College in Canada.

Next, Raymond O. Darling, assistant to the director of educational relations at General Motors, elaborated on a query, "Why does the General Motors Corporation do what it does in its relationship with institutions of higher learning—or with institutions of learning at any level, for that matter?" As a part of his discussion of the GM position in this regard, a quotation attributed to Alfred P. Sloan Jr., is expressive: "In our existing industrial economy the only difference of a fundamental nature between one business and another operating in the same field is the people. The same sources of raw material are available to all. The same equipment will be furnished to anyone who may buy. The existing standards of technology are largely a matter of common knowledge. The same markets are available. All these means are open to everyone and generally speaking on equal terms. The one major difference is people." Mr. Darling further emphasized that his company looks to the colleges and universities to provide young men—people—in the never-ending search to fill posts in the organizational ladder.

The last presentation on this panel was by Eugene H. Case, director of college and university relations, Deere and Company, who based his remarks upon a statement, "From the viewpoint of industry, interest in our educational system may be divided into, first, the intense personal and immediate requirements to enable us to meet the problems now at hand; and secondly, the broad and long-range aspect to equip us to meet the future in this rapidly changing age."

At luncheon immediately thereafter, Harlan H. Hatcher, president of the University of Michigan, eloquently argued his reasons for a continued favorable climate for expanded collaboration by industry and the academic world. From a point of vantage unlike those of his audience, Dr. Hatcher presented a view singularly appropriate, and in a manner calculated to challenge his listeners to action.

Continuing Education in Industry

"Continuing Education by Industry in Industry" provided the theme for the second panel discussion. H. L. Shepherd of Canadian Westinghouse Ltd., Hamilton, Ont., initiated his remarks by seeking an answer to the total question of engineer-industry relationships. "What is an engineer?" and "For what tasks in industry ought the engineer be educated?" He referred to a definition of engineering once stated by President Doherty of Carnegie Tech: "Engineering

At ASME-EIC Education Conference: *Left to right,* O. B. Schier, II, ASME secretary; E. W. Allardt, vice-president, ASME Region V; K. F. Tupper, EIC president; and H. G. Conn, Queen's University, Kingston, Ont.

Panel which discussed "Philosophy of Co-operation Between Industry and Higher Education." Speakers shown with Mr. Allardt, *left to right,* who represented ASME President Landis: E. H. Case, Ira Needles, and R. O. Darling.

A. W. Brown, John Gammell, and H. L. Shepherd, shown *left to right,* were participating members of panel covering "Continuing Education by Industry in Industry"

Members and moderator of the panel on "Support by Industry of Higher Education," included, *left to right,* E. T. Stewart; J. M. Brown, moderator; G. R. Lord; and Pierre Gendron

is the art, based primarily on sound training in mathematics and the physical sciences, of utilizing, economically, the forces and materials of nature for the benefit of man," to which Mr. Shepherd added, "Fundamentally the pace of progress being what it is, the universities can hardly be expected to do more than provide sound training in mathematics and the physical sciences, and to add some fundamentals about the forces and materials of nature, and economics. Perhaps through a sprinkling of the humanities to touch on man, and the things which benefit him." Then he concluded, "Industry must pick up the task of realistic education about utilizing, economically, for the benefit of man."

John Gammell, director of graduate training program, Allis Chalmers Manufacturing Company, explained the procedure by which his organization provides further educational opportunities for engineering personnel, through training programs within Allis-Chalmers as well as by financial support and personal encouragement to pursue further course study at institutions of higher learning.

The final formally presented comments in the afternoon symposium were contributed by Alan W. Brown, president of the Metropolitan Educational Television Association, New York. From a background as a provost at Union College and later president of Hobart College, the speaker advocated that industry recognize the need for continued education of the whole man, not only in areas of the useful and the applied, but in terms of the widening of horizons and the encouragement of imagination. He emphasized the potentialities of both closed and open television as particularly effective modes for industry educational and training purposes. Throughout this session, R. D. Richmond, chief engineer of special weapons, Canadair, Montreal, Que., moderated the discussion, enthusiastically encouraging the conferees to share in the deliberations.

On the evening of the first conference day, the entire group enjoyed a social hour and banquet after which C. M. Anson, vice-president and general manager, Dominion Steel and Coal Corporation, Sydney, Nova Scotia, was the speaker. Immediate past-president of the EIC, his contribution to the issues under consideration was tempered by years of acquaintance with the graduates of engineering schools and by his recognition of the special needs of industry for individuals each of whom will be well equipped "with a broad basic foundation that will enable him to adapt himself to the rapidly changing scientific and technical fields, and to absorb the increasing responsibilities which he will encounter."

Industry Supports Higher Education

In the final discussion period, J. Moreau Brown, administrator, corporate support programs for the General Electric Company, was the moderator. His panel directed attention to the theme "Support by Industry of Higher Education." Two educators from Canada, Dean Pierre Gendron of the Faculty of Pure and Applied Science at the University of Ottawa, and G. Ross Lord, head, mechanical-engineering department, University of Toronto, spoke with authority stemming from many years of academic experiences. Dean Gendron referred to (1) the need for industry, as champions of free enterprise, to help education; (2) the form of support that industry should give to higher education, and how these aims may be realized. Professor Lord devoted a portion of his presentation to a recital of the graduate programs in engineering in Canada and why industry should support this particular facet of higher education. He also described the engineering teacher, his niche in the educational program, and how industry might co-operate with such individuals in the fulfillment of their goals.

Finally Ernest T. Stewart, executive director of the American Alumni Council, explained with uncommon clarity the varied programs now in force for financial support by industry of educational institutions.

Tangible values to be gained from such a conference, an activity sponsored by the ASME Board on Education, are difficult if not impossible to measure. However, if expressions of keen satisfaction with the program by conferees are evidence of the worth of such an activity, the conference may well be judged a success.

ASME Los Angeles Section Meeting

THE second annual ASME Los Angeles Section Professional Division conference has been set for Jan. 21, 1959, at the Huntington-Sheraton Hotel in San Marino. The theme, "Changing Horizons," will be the common meeting ground for distinguished speakers representing each of the section's ten professional divisions. The high light of the day's activities will be the evening banquet at which a conference keynote speaker will deliver an address.

Conducted for the National Junior Committee

N. J. VIEHMANN[1]

JUNIOR FORUM

Cincinnati Associate Members in Action

By W. L. Merritt[2]

A MAN requires exercise if he is going to keep his body healthy and fit for vigorous living. Similarly, an organization such as ASME must exercise its members if it is going to maintain the virility needed for fulfilling its rightful place in society.

It is often a problem to determine how to motivate young engineers into becoming active associate members. One accepted step in problem solving is to find out what others have tried and whether they were successful or not. It also helps to analyze the reasons why each method produced the results that it did.

Let us then look at some of the ways the Cincinnati Section has exercised its associate members, which at the present time number over 400 engineers and approximately 65 per cent of the section membership.

ASME Activities for Cincinnati Associate Members

In ASME, becoming active almost invariably means working on a committee. Almost every committee will welcome the sincere offer of an enthusiastic associate member to help. This not only lightens the load for the other members, but often gives the committee a broadened picture of its responsibilities and opportunities. In the Cincinnati Section, the officers encourage and "sell" the associate members on taking an active part in committee work. This has resulted in several of the associate members being elected directors of the section because of their previous participation in committee work.

Each year, the associate members are responsible for planning, organizing, and conducting several programs. A Dinner-Dance, sponsored by the associates, helps to get the fall season started with a bang. The second Annual Dance this September was a big success. One advantage it secures is "Wife Co-operation" for ASME activities the remainder of the year.

The April meeting is known as the Student Thesis Meeting. Students from the engineering colleges at the University of Cincinnati and the University of Dayton compete for a prize. The speakers are rated on the standard ASME Rating Forms by the judges. In addition, the students of both Universities are guests of individual members of the section in a "Father-Son" arrangement.

The opportunities for encouraging young students of engineering are great in such an undertaking and this is without a doubt one of the obligations that an associate member shares with all other members. This is also important because it is much easier for the student to picture himself in the shoes of a young associate than those of an older veteran of many years of experience.

Another area of activity in which associates participate is counseling, especially high-school students. It is a well-publicized fact, these days, that many qualified young fellows do not continue their schooling beyond high school. The recent scientific achievements of the Russians have demonstrated that we, as a nation, will have to find a way to motivate those qualified to earn a college degree to fulfill their potential.

It is an obligation of those in the profession to be leaders and a guiding force in this undertaking.

Activities With Other Societies

In the Cincinnati area, this program is sponsored by the Engineering Society of Cincinnati. Several of the ASME associates and members take an active part in this program by explaining the requirements for education, the duties, and the privileges of mechanical engineers. This past year, the attendance and interest reached a new high. Despite this successful program, many more high-school pupils need to be reached and their future possibilities as engineers or scientists discussed in informal thoughtful sessions.

The opportunity for more associates

Two newly elected directors of the Cincinnati Section, Associate Members W. V. Chambers, *left,* and Jack P. Favre, *second from left,* discuss ASME activities with W. G. Cornell, *second from right,* secretary-treasurer, and Robert Nelsen, *right,* Section chairman. Both Mr. Nelsen and Mr. Chambers have served on the National Junior Committee.

[1] Product Planning Engineer, Western Electric Company, North Andover, Mass. Assoc. Mem. ASME.

[2] Service Engineer, General Electric Company, Cincinnati, Ohio. Mem. ASME.

to help in this endeavor is being stressed by the Cincinnati Section of the Society.

There Is Work to Be Done

Associate members predominate at the present time on such committees as the membership, publicity, and program committees. In addition, there is the Junior Committee itself. This committee, which is charged with being especially concerned with the welfare of associate members particularly self-development, often undertakes a variety of tasks for the Section. The Cincinnati Committee publishes a Junior Newsletter to keep all associates abreast of significant ASME news.

The purpose of the afore-mentioned examples has been to show associates that there is plenty of opportunity for work in an ASME Section. The main requirement for getting started in this work is a sincere desire to become active in ASME and making this desire known to one of the officers or a member of the Junior Committee.

There is no question that one of the best ways of learning is by doing. The best way to do something is to volunteer to work on a committee.

The experience of the Cincinnati Section proves that work as an associate member is important. The present chairman of the Section has held practically every office in the Section plus several committee assignments. In addition, he was active as the National Junior Committee chairman one year. The significant point of this example is that practically all of these assignments were performed as an associate member, his transfer to member having taken place only two years previous to his election to chairman of the Section.

If The American Society of Mechanical Engineers is to be a healthy, vigorous organization, it must use the abilities and potential contributions of all its members. By example, we have tried to show what associates can do if they are willing to work. The answer to this challenge will determine the size of ASME accomplishments in the future.

Chairman's Corner

As THIS is my last opportunity to express myself as the National Junior Committee Chairman, I wish to thank those who have helped, by their personal contributions, themselves by helping the Society.

An invitation is extended to all the Associate Members to attend the National Junior Committee Sessions at the Annual Meeting; this includes the Executive Meeting on Dec. 2, 1958, Tuesday, 2:30 p.m.

Your 1959 Executive National Junior Committee is composed of the following:

W. M. Morley, *Chairman*, Philadelphia, Pa.; N. J. Viehmann, *Vice-Chairman*, Andover, Mass.; C. D. Hansen, *Secretary*, Cambridge, Mass.; W. V. Chambers, *Past-Chairman*, Cincinnati, Ohio; G. A. Fryling, *Senior Adviser*, New York, N. Y.; H. B. Lindstrom, Washington, D. C.; H. N. Weinberg, Linden, N. J.; D. E. Glesmann, St. Paul, Minn.; R. S. Touma, Bayside, N. Y.; G. Wylie, Durham, N. C.; E. T. Selig, Chicago, Ill.

W. V. Chambers, Chairman,
National Junior Committee.

ASME COMING EVENTS

Feb. 23–26, 1959

ASME Symposium on Thermophysical Properties, Purdue University, Lafayette, Ind.

March 8–12, 1959

ASME Gas Turbine Power Conference and Exhibit, Netherlands-Hilton Hotel, Cincinnati, Ohio

March 8–12, 1959

ASME Aviation Conference, Statler-Hilton Hotel, Los Angeles, Calif.

March 16–17, 1959

ASME Lubrication Conference, The Franklin Institute, Philadelphia, Pa.

March 29–April 1, 1959

ASME Instruments and Regulators Conference, Case Institute of Technology, Cleveland, Ohio

March 31–April 2, 1959

American Power Conference, Hotel Sherman, Chicago, Ill.

April 5–10, 1959

Nuclear Congress, Cleveland Auditorium, Cleveland, Ohio

April 13–15, 1959

ASME Hydraulics Conference, University of Michigan, Ann Arbor, Mich.

April 19–23, 1959

ASME Oil and Gas Power Conference, Shamrock-Hilton Hotel, Houston, Texas

April 23–24, 1959

ASME Management-SAM Conference, Statler-Hilton Hotel, New York, N. Y.

April 29–May 3, 1959

ASME Metals Engineering Conference, Sheraton-Ten Eyck Hotel, Albany, N. Y.

May 4–5, 1959

ASME Maintenance and Plant Engineering Conference, Edgewater Beach Hotel, Chicago, Ill.

May 12–14, 1959

ASME Production Engineering Conference, Statler-Hilton Hotel, Detroit, Mich.

May 25–28, 1959

ASME Design Engineering Conference, Convention Hall, Philadelphia, Pa.

June 14–18, 1959

ASME Semi-Annual Meeting, Chase-Park Plaza Hotel, St. Louis, Mo.

June 18–20, 1959

ASME Applied Mechanics Conference, Virginia Polytechnic Institute, Blacksburg, Va.

August 9–12, 1959

ASME-AIChE Heat-Transfer Conference, University of Connecticut, Storrs, Conn.

September 17–18, 1959

ASME-AIEE Engineering Management Conference, Statler-Hilton Hotel, Los Angeles, Calif.

September 20–23, 1959

ASME Petroleum Mechanical Engineering Conference, Rice Hotel, Houston, Texas

Sept. 27–Oct. 1 1959

ASME-AIEE National Power Conference, Hotel Muehlebach, Kansas City, Mo.

Oct. 20–22, 1959

ASME-ASLE Lubrication Conference, Hotel Sheraton-McAlpin, New York, N. Y.

November 29–December 4, 1959

ASME Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

(*For Meetings of Other Societies, see page 113*)

NOTE: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

ASME Symposium on Thermal Properties—Four-Day Technical Program at Purdue

(*Continued from page 123*)

Technical Program

▶ MONDAY, February 23

Session 1, Theoretical Estimation of Transport Properties 9:00 a.m.

Chairman: *John Richardson*, Hughes Aircraft Corp.

Vice-Chairman: *P. E. Liley*, Purdue Univ.

Relations Between Gas Absorptivities and Emissivities, by *S. S. Penner, D. Olfe,* and *A. Thomas*, California Inst. of Tech.

Theories of Gas-Transport Phenomena, by *J. S. Dahler*, Wright-Patterson AFB

Review of Modern Theory of the Thermal Conductivity, by *D. J. Schleef*, Purdue Univ.

Session 2, Review of Recent Work on Transport Properties 2:00 p.m.

Chairman: *E. V. Somers*, Westinghouse Elec. Corp.

Vice-Chairman: *J. F. Wachunas*, The Babcock & Wilcox Co.

Survey of Recent Work on the Viscosity, Thermal Conductivity, and Diffusion of Gases and Gas Mixtures, by *P. E. Liley*, Purdue Univ.

Review of Available Experimental Data on the Viscosity of Steam, by *J. Kestin* and *J. R. Moszynski*, Brown Univ.

Systems and Procedures Developed for the Search, Coding, and Mechanized Processing of Bibliographic Information on Thermophysical Properties,[1] by *Y. S. Touloukian, C. H. Stevens, R. H. Rodine, T. Wing,* and *D. Smith*, Purdue Univ.

Transport Properties of Multicomponent Gas Mixtures at High Temperatures, by *C. W. Baulknight*, Gen. Elec. Co.

Session 3, Thermodynamic Properties—Gases and Liquids 8:00 p.m.

Chairman: *N. A. Hall*, Yale Univ.

Vice-Chairman: *W. E. Ibele*, Univ. of Minnesota

Thermodynamic Properties of Methane-Nitrogen Mixtures, by *R. T. Ellington, O. T. Bloomer, B. E. Eakin,* and *D. C. Gami*, Inst. of Gas Technology

Correlations and Equations Used in Calculating the Thermodynamic Properties of Freon Refrigerants, by *J. J. Martin*, Univ. of Michigan

The Unmixing of Metal Solutions by a Temperature Gradient, by *R. A. Oriani*, Gen. Elec. Co.

Thermodynamic and Electrical Properties of Nitrogen at High Temperature, by *F. Martinek*, Gen. Elec. Co.

Isentropic Checking of Vapor Tables at Saturation Boundary Lines and Ways of Improving Them, by *U. Issarescu*, Switzerland

▶ TUESDAY, FEBRUARY 24

Session 4, PVT Data and Equation of State 9:00 a.m.

Chairman: *Leo Friend*, M. W. Kellogg Co.

Vice-Chairman: *T. W. Jackson*, Georgia Inst. of Tech.

The Liquid Pressure-Volume-Temperature Relationships, Dew and Bubble Point Pressures and Densities of a Binary Mixture Containing 75 wt. % Freon-12 wt. % Freon-22, by *D. White, E. F. Neilson,* and *J. Farnham*, Ohio State Univ.

Vapor-Liquid Phase Equilibria in the Binary Systems of Methane, Ethane, and Nitrogen, by *R. T. Ellington, B. E. Eakin, J. D. Parent, D. C. Gami,* and *O. T. Bloomer*, Inst. of Gas Technology

Application of the B-W-R Equation of State to Hydrocarbon-Carbon Dioxide Mixtures, by *B. E. Eakin* and *R. T. Ellington*, Inst. of Gas Technology

An Equation for the Critical Isotherm of Gases, by *U. K. Rombusch*, Technische Hochschule, Karlsruhe

The Virial Equation Applied to Steam, by *P. E. Liley*, Purdue Univ.

[1] Presented by title only. Paper will be discussed at TPRC annual meeting.

Session 5, Thermodynamic Properties of Boron Compounds 2:00 p.m.

Chairman: *J. F. Masi*, Callery Chemical Co.

Vice-Chairman: *S. Gratch*, Rohm and Haas Co.

Characterization of Unusual Gaseous Oxide and Hydroxide Molecules in M-O-H Systems at High Temperatures, by *F. T. Greene, S. P. Randall,* and *J. L. Margrave*, Univ. of Wisconsin

Thermochemistry and Thermodynamic Functions of Some Boron Compounds, by *W. H. Evans, E. J. Prosen,* and *D. D. Wagman*, Nat. Bu. of Stds.

The Combustion of Boron Hydrides, by *W. G. Berl* and *W. Reuich*, Applied Physics Lab.

Ideal and Real Gas Thermal Functions by the LGP-30 Digital Computer: Application to Diborane, by *H. J. Galbraith* and *J. F. Masi*, Callery Chem. Co.

The Low-Temperature Thermal and Chemical Thermodynamic Properties of Boron Compounds, by *E. F. Westrum, Jr.*, Univ. of Michigan

▶ WEDNESDAY, FEBRUARY 25

Session 6, Transport Properties—Experimental 9:00 a.m.

Chairman: *C. F. Bonilla*, Puerto Rico Nuclear Center, Univ. of Puerto Rico

Vice-Chairman: *I. B. Fieldhouse*, Armour Res. Foundation

Thermal Conductivity of Some Epoxy Plastics, by *J. E. Jaussen* and *R. H. Torborg*, Minneapolis-Honeywell Regulator Co.

Measurements of the Thermal Conductivity of Milk, by *W. Leidenfrost*, Aachen, Germany

Thermal Conductivity of Helium-Air Mixtures, by *E. R. G. Eckert, W. E. Ibele,* and *T. F. Irvine*, Univ. of Minnesota

Thermal Conductivity of Liquid Ozone, by *T. E. Waterman*, Armour Res. Foundation

Thermal Diffusivity of Nitrogen as Determined by the Cyclic Heat-Transfer Method, by *W. B. Harrison, W. C. Boteler,* and *J. M. Spurlock*, Georgia Inst. of Tech.

Session 7, Transport Properties—Experimental 2:00 p.m.

Chairman: *A. G. Lundquist*, ONR, Power Branch

Vice-Chairman: *J. P. Hartnett*, Univ. of Minnesota

Experiments in the Molecular Diffusion of Gases at High Temperatures, by *A. A. Westenberg* and *R. E. Walker*, Applied Physics Laboratory

The Effect of Moderate Pressures on the Viscosity of Five Gases, by *J. Kestin* and *W. Leidenfrost*, Brown Univ.

The Viscosity of Steam, by *F. A. Thomas, Jr.*, and *T. W. Jackson*, Georgia Inst. of Tech.

The Viscosity of Steam-Nitrogen Mixtures at Atmospheric Pressure and Elevated Temperatures, by *C. F. Bonilla, S. E. Greer,* and *E. A. Taikeff*, Columbia Univ.

Fluid Thermal Conductivity by a Transient Method, *P. H. G. Allen*, British Thomson-Houston Co.

Thermodynamic and Transport Properties of Gaseous Carbon Dioxide, by *L. H. Chen*, Elec. Boat

▶ THURSDAY, FEBRUARY 26

Session 8, High-Temperature Transport Properties of Metals and Ceramics 9:00 a.m.

Chairman: *Jules Wittebort*, WADC, Materials Section

Vice-Chairman: *D. J. Schleef*, Purdue Univ.

Thermal Expansion Coefficients of Binary Substitutional Solid Solution Alloys, by *W. M. Spurgeon*, Gen. Elec. Co.

Thermal Diffusivity of Metals at Elevated Temperatures, by *C. P. Butler* and *E. C. Y. Inn*, U. S. Naval Radiological Defense Lab.

Thermal Conductivity of Aircraft Structural and Reactor Materials, by *I. B. Fieldhouse*, Armour Res. Foundation

The Total Emissivity of Aircraft Construction Materials, by *J. O. Morris, B. Schurin,* and *O. H. Olson*, Armour Res. Foundation

Specific Heat of Materials, by *J. I. Lang*, Armour Res. Foundation

Session 9, High-Temperature Thermodynamic Properties of Gases 2:00 p.m.

Chairman: *E. F. Lype*, Gen. Elec. Co.

Vice-Chairman: *P. S. Lykoudis*, Purdue Univ.

Mechanized Computation of Thermodynamic Tables at the National Bureau of Standards. II. The Calculation of the Equilibrium Composition and Thermodynamic Properties of Dissociated and Ionized Gaseous Systems, by *J. Hilsenrath, M. Klein,* and *D. Y. Sumida*, Nat. Bur. of Stds.

Equilibria in $C+H_2$ and $C+2H_2$ Systems at Temperatures Between 1000 K and 6000 K, by *H. Kroepelin* and *E. Winter*, Technische Hochschule, Braunschweig

Equilibria in a Thermal Plasma Composed of C + H_2 and C + $2H_2$ in a Temperature Range From 5000 K to 50,000 K at a Total Pressure of 1 Bar, by *H. Kroepelin* and *K. K. Neumann*, Technische Hochschule, Braunschweig

Mollier Enthalpy-Entropy Charts for High-Temperature Plasmas, by *F. Bosnjakovic, W. Springe, K. F. Knoche,* and *P. Burgholte*, Technische Hochschule, Braunschweig

The over-all photo shows the Purdue University Campus. Symposium on Thermal Properties of Gases, Liquids, and Solids to be held Feb. 23–26, 1959, will be housed in the Memorial Center and Purdue Union Club shown in *right foreground.*

ASME CODES AND STANDARDS WORKSHOP

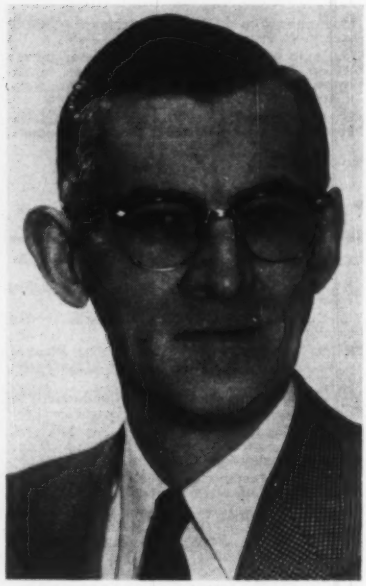
New Chairman for B18 Subcommittee 3

APPOINTMENT of H. F. Phipard as chairman of Subcommittee 3 on Slotted and Recessed Head Screws, of Sectional Committee B18, was announced at the meeting of Subcommittee 3 on October 30.

Mr. Phipard of Continental Screw Company has long been active as a member of Subcommittee 3 and various of its subgroups.

The resignation of Frank P. Tisch as chairman of Subcommittee 3 was received with deep regret, because of Mr. Tisch's long and effective service as chairman, not only in developing the 1946 standard, but during the long and difficult expansion and development of that standard into four separate product standards. Three of these have been approved as American Standard and the fourth is shortly to go to sponsors for approval.

The ever-changing nature of the engineering-standards field is pointed up by the fact that the chief subject on the agenda of the meeting was proposed revisions to American Standard Tapping Screws, which had been approved as American Standard only this year.



W. P. Kliment

W. P. Kliment Awarded Standards Medals

The highest awards in the field of voluntary standards were made this year to John R. Suman, of Houston, Texas, and William P. Kliment, Mem. ASME, Chicago, Ill., by the American Standards Association.

The two gold medals were presented to the recipients at the award luncheon on November 19, during the Ninth Annual Conference on Standards, held at the Hotel Roosevelt, New York, N. Y., November 18–20.

John R. Suman, a retired vice-president and a director and member of the executive committee of Standard Oil Company (N. J.), and an honorary director of the American Petroleum Institute, was awarded the Howard Coonley Medal "for his leadership role in the advancement of the national economy through voluntary standards."

William P. Kliment, engineer of standards, Crane Company was awarded The Standards Medal for his "indefatigable efforts and outstanding achievements in the practical development and application of voluntary standards." Mr. Kliment has been active on more than 100 standardization committees of several trade and professional societies, among them The American Society of Mechanical Engineers, the Manufacturers Standardization Society of the Valve and Fittings Industry, the American Standards Association, the American Society for Testing Materials, the American Petroleum Institute, and the American Welding Society.

The Standards Medal is awarded yearly to an individual who has played an outstanding role in the practical work of developing and using national standards.

Nominations for ASME Honors Sought

MEMBERS and agencies of The American Society of Mechanical Engineers including Boards, Committees, Sections, and Professional Divisions are invited to submit nominations for Society honors and awards as described in the ASME Honors Manual MS-71. Nominations for 1959 must be in the hands of the Board of Honors prior to March 1, 1959.

As important changes have been made in the nominating procedures and the Manual, it is *essential* that those wishing to make a nomination secure a copy of the Honors Manual dated October, 1958, by writing to the Board of Honors, ASME, 29 West 39th Street, New York 18, N. Y. Please note carefully information given on pages 3, 6, 11, 12, 13, 14, and Appendix I for the major changes adopted by the Council.

Lubrication Specialists Gather in Los Angeles for Fifth ASME-ASLE Conference

MORE than half of the 26 papers presented at the Fifth Annual ASME-ASLE Lubrication Conference were of special interest to engineers concerned with missile, aircraft, and atomic energy power-plant design and operation. Held at the Statler-Hilton Hotel, Los Angeles, Calif., October 13–15, the meetings drew 84 lubrication specialists from the East. Although the total attendance was not as high as recent conferences, it was good considering present economic conditions and the location of the meeting.

In order to handle the large number of papers, two author-reporter type sessions were adopted. This proved particularly successful in the session devoted to basic studies in friction and wear. The authors of the five papers ably briefed their work and then formed a discussion panel. Dis-

cussion between the authors was lively and this broke the ice for unusually extensive comments from the floor.

In the second session on friction and wear, two papers dealt with the use of zinc dialkyl dithiophosphate as an anti-wear additive in gasoline-engine lubricants. One investigator used radioactive techniques, and the other microinterferograms of valve-lifter-foot surfaces to detect surface roughness. These papers brought forth a spirited discussion concerning the stability and effectiveness of various types of zinc dialkyl dithiophosphate.

Two papers dealing with the effects of high-energy radiation on lubricating oil were of specific interest to those engineers concerned with atomic energy power plants. One paper indicated that exposure to 45×10^6 rods is the lubricating dosage for petroleum turbine-type lubricating oils while the other paper presented data on a radiation resistant lubricant that would be usable to a total dosage of 10^{10} roentgen.

Of special interest to aircraft and missile designers were papers dealing with rolling element bearings and seals operating at extreme high and low temperatures, and at speeds of over 100,000 rpm. Evaluations of materials, fatigue, and liquefied nitrogen and hydrogen as the lubricant were covered. Also among a group of solid, mathematical papers were two dealing with gas-lubricated plan radial and sector thrust bearings.

The planned program for the women was somewhat upset by the closing of Disneyland and Knotts Berry Farm on the day originally scheduled. This all-day trip was, however, made on Wednesday instead. On Tuesday, they visited the Farmers Market and a television studio.

Availability List: ASLE-ASME Lubrication Conference

THE papers in this list are available in separate copy form until Aug. 1, 1959. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers.

58—Lub-1 Axial, Relative Motion of a Circular Step Bearing, by L. LICHT

58—Lub-2 Analysis and Characteristics of the Three-Lobe Bearing, by O. PINKUS

58—Lub-3 Elastic and Damping Properties of Cylindrical Journal Bearings, by B. STERNLICHT

58—Lub-4 On the Mechanism of Gear Lubrication, by V. N. BORSOFF

58—Lub-5 The Gas-Lubricated Sector Thrust Bearing, by C. C. MOW and EDWARD SAIBEL

58—Lub-6 Friction and Wear of Metals to 1000 C, by E. P. KINGSBURY and E. RABINOWICZ

58—Lub-7 The Influence of the Molecular Mean Free Path on the Performance of Hydrodynamic Gas Lubricated Bearings, by ALBERT BURGDORFER

58—Lub-8 An Investigation of Dry Adhesive Wear, by R. P. STEIJN

58—Lub-9 Sliding Wear and Metal Transfer Under Unlubricated Conditions, by R. P. STEIJN

58—Lub-10 An Accessory Manufacturer's Approach to Bearing and Seal Development, by STANLEY GRAY

ASME Presents "Hook Tool" to Smithsonian

A FINE example of a curious and nearly extinct species of machinist tool, valuable as a relic and rich in its association with early leaders of the iron and steel industry, was presented recently to the Smithsonian Institution by The American Society of Mechanical Engineers, through the Society's Secretary, O. B. Schier, II.

The tool is called a hook tool and was made by the late John Fritz, past-president ASME, in the 1840's, more than a century ago. It is a hand tool for turning metal on a lathe. It has a 2-ft-long wooden handle, which is tucked under his armpit by the machinist, and a blunt nose cutting tool, which has tooth-like serrations to grip the tool rest on the lathe. It required courage and considerable brawn to hold the cutting edge of the tool against the rapidly spinning workpiece in the lathe, because the tool could easily become snagged in the workpiece, with painful results to the machinist.

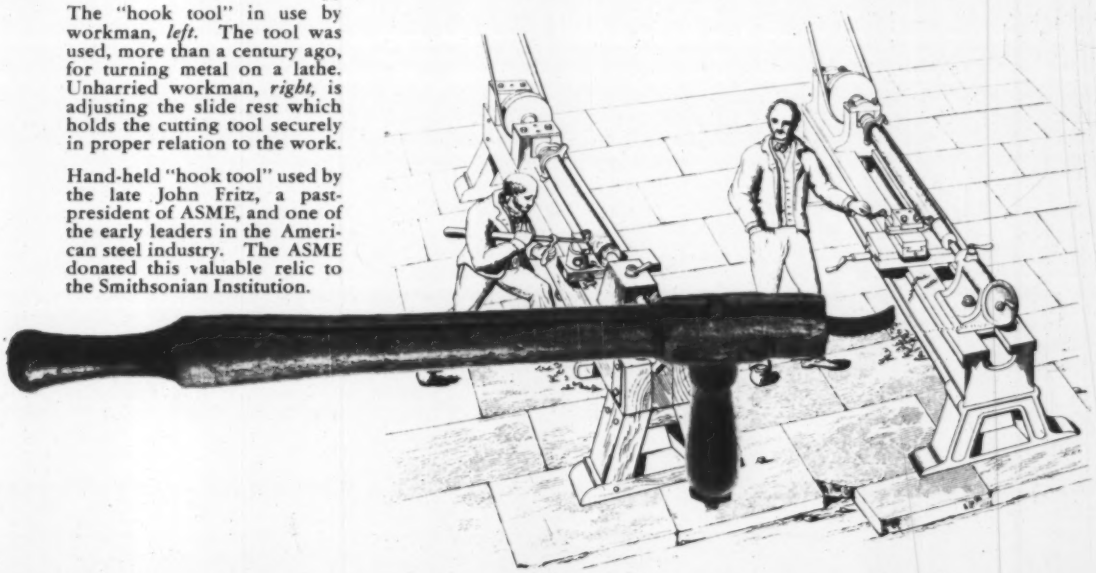
While the modern lathe has a rigidly mounted tool holder, which gives the operator complete control of the depth of cut and rate of feed, no such refinements were used on many of the wooden-bed lathes of a hundred years ago, such as those that Mr. Fritz first encountered as an apprentice.

The tool was given by Mr. Fritz, one of the leading innovators in the early days of steel, to ASME in 1896, upon the occasion of his address as President of the Society.

This hook tool has been added to the rapidly growing collection of machine tools in the United States National Museum, being collected for the purpose of making available to present and future generations of engineers and craftsmen the accumulated experience of pioneers in the field.

The "hook tool" in use by workman, *left*. The tool was used, more than a century ago, for turning metal on a lathe. Unharried workman, *right*, is adjusting the slide rest which holds the cutting tool securely in proper relation to the work.

Hand-held "hook tool" used by the late John Fritz, a past-president of ASME, and one of the early leaders in the American steel industry. The ASME donated this valuable relic to the Smithsonian Institution.



1958 West Coast Applied Mechanics Conference Held at University of California, Los Angeles

THE 1958 West Coast Conference of Applied Mechanics sponsored by the Applied Mechanics Division of The American Society of Mechanical Engineers in conjunction with the American Society of Civil Engineers was held September 8-10 at the University of California, Los Angeles.

The six-session technical program included discussions on plates, shock, vibration and impact, shells, and stress analysis and materials. Twenty-six papers were presented during the three-day conference, which attracted a large audience.

A tour of the UCLA engineering facilities was scheduled as well as the Applied Mechanics Luncheon.

Availability List: ASME Applied Mechanics Conference

THE papers in this list are available in separate copy form until July 1, 1959. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers.

58—APM-1 Response of a Simply Supported Timoshenko Beam to a Purely Random Gaussian Process, by J. C. SAMUELS and A. C. ERINGEN

58—APM-2 Physical Properties of Plastics for Photothermoelastic Investigations, by H. TRAMPOSCH and G. GERARD

58—APM-3 Some Solutions of the Timoshenko Beam Equation for Short Pulse-Type Loading, by H. J. PLASS, JR.

58—APM-4 The Plastic Deformation Due to Impact of a Cantilever Beam With an Attached Tip Mass, by T. J. MENTEL

58—APM-5 Some Shock Spectra Characteristics and Uses, by Y. C. FUNG and M. V. BARTON

58—APM-6 Design of Accelerometers for Transient Measurements, by SHELDON RUBIN

58—APM-7 The Vibration of a String Having a Uniform Motion Along Its Length, by F. R. ARCHIBALD and A. G. EMSLIE

58—APM-8 Stresses Produced in a Half Plane by Moving Loads, by J. COLE and J. HUTH

58—APM-9 Theory of Pitch and Curvature Corrections for the Helical Spring—Part 2 (Torsion), by C. J. ANCKER, JR., and J. N. GOODIER

58—APM-10 Pitch and Curvature Corrections for Helical Springs, by C. J. ANCKER, JR., and J. N. GOODIER

58—APM-11 Theory of Pitch and Curvature Corrections for the Helical Spring—Part 1 (Tension), by C. J. ANCKER, JR., and J. N. GOODIER

58—APM-12 Large Symmetric Deflections of Annular Plates, by G. A. WEMPNER and R. SCHMIDT

58—APM-13 The Flexure of a Uniformly Pressurized, Circular, Cylindrical Shell, by J. D. WOOD

58—APM-14 Transient and Residual Stresses in Heat-Treated Plates, by H. G. LANDAU and J. H. WEINER

58—APM-15 Response of Complex Structures From Reed-Gage Data, by SHELDON RUBIN

58—APM-16 A Refined Theory of Elastic Orthotropic Plates, by S. J. MEDWADOWSKI

58—APM-17 A Theory of Elastic, Plastic, and Creep Deformations of an Initially Isotropic Material Showing Anisotropic Strain-Hardening, Creep Recovery, and Secondary Creep, by J. F. BESSELING

58—APM-18 Large Deflection of Stiffened Plates, by W. G. SOPER

ASME Elects 13 to Grade of Fellow Member

THE American Society of Mechanical Engineers has honored 13 of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow, one must be an engineer with acknowledged engineering attainment, have 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and be a Member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or Members of the Society to the Council, to be approved by Council.

The men who were so honored for their outstanding contributions to their profession and to the Society are:

Arthur M. Perrin

ARTHUR MITCHELL PERRIN, president, National Conveyors Company, Inc., Fairview, N. J., and inventor and designer, is well known as a leader in the field of management. He has held his present office since 1942, after having been vice-president in charge of sales and engineering of the company's New York and New England District, 1939-1942; and executive in charge of engineering, 1933-1939. He joined the company in 1928 when it was the Girtanner Engineering Corporation. In his career which spans 30 years, he has designed and constructed conveyer systems for large industrial plants. The National ChipVeyor System, his development, is universally used in metalworking plants for the conveying and processing of metal turnings and borings. He is an authority in the field of pneumatic conveying and has patented equipment for the conveying of dry pulverized or granular material; metal chips and borings; resins; pharmaceutical materials; skeleton scrap; glass cullet; gunpowder, small finished parts, and the like. He has written papers for presentation at meetings of ASME and other professional societies. He acted as associate editor of "Salvage for Industry," published by the Technical Service Section, Industrial Salvage Branch, War Production Board. In addition to industrial and engineering leadership, Mr. Perrin has done much to promote professional society activity and engineering management both here and abroad. He has been active in the ASME Management Division, and in 1953 was chairman of its Executive Committee. He is now a member of its Advisory Board. In 1957, he was elected chairman of the Metropolitan Section. Mr. Perrin was recently elected to the office of Director in The American Society of Mechanical Engineers. He has been an ASME representative on the Gantt Medal Board of Award and on the board for the Council for International Progress in Management (U.S.A.), Inc. He is a member also of the Society for the Advancement of Management and has helped to organize its Bergen County, N. J., Chapter. In 1954, under the auspices of the National government, he visited Europe to extend to European Management the opportunity of discussing American management methods and their application to the European Program for Economic Development. Mr. Perrin is a contributing author to the "Materials Handling Handbook," sponsored by The American Society of Mechanical Engineers and the American Materials Handling Society, published in 1958 by the Ronald Press. He is a member of the Advisory Board of the First National Bank of Jersey City, N. J.

George A. Porter

GEORGE ARTHUR PORTER, vice-president in charge of engineering, construction, and operations, Detroit Edison

Company, Detroit, Mich., has made outstanding contributions to the engineering profession through his leadership and through the development of original engineering principles in the field of power generation. He joined Detroit Edison in 1925 and successively held posts in the research, construction, and production departments. In 1946, he became assistant superintendent at the Delray Power Plant; went on to become assistant chief engineer in charge of power plants in 1949; in 1951, he became manager of construction; and in 1952 assumed his present position. In that post he is charged with the over-all responsibility for the design, construction, operation, and maintenance of the company's plants and systems and for all major engineering decisions involved in these projects. During this period, a total of 1,470,000 kw of generating capacity have been placed under construction and 885,000 kw placed in service. Among his outstanding achievements is the development of a low-temperature air preheater which has materially advanced the art of power generation. He has been personally responsible for conducting a soil study at one of his company's plants which is located in an area from which salt is being removed by the solution mining process. This study has resulted in a bill being brought before the State Legislature to define more clearly the responsibilities of companies using solution-mining techniques. He has created a Detroit Edison Committee to study the use of high-tension transmission systems to supplement and, eventually, to replace present 120-kv systems. Several trips to Europe have taken him to various utilities on the Continent to study the operations of their high-tension systems. In August, 1954, he was appointed chairman of the Detroit Sponsor Group to lead the ECPD activity of the Professional Training Committee whose objective is to promote the training and development of young engineers. He is a member of AIEE, the Association of Edison Illuminating Companies, Committee of Power Generation, Engineering Society of Detroit, the International Conference on Large Electric High Tension Systems; professional clubs; and Tau Beta Pi, Pi Tau Sigma, and The Newcomen Society of America.

Harold S. Sizer

HAROLD SCOTT SIZER, director of design for machine tools, Brown & Sharpe Manufacturing Company, Providence, R. I., has been recognized for his contributions in the fields of machine design and standards. As a trainee and test engineer, he joined Brown & Sharpe in 1929. Since then he has successively been standards engineer and assistant director of design. In 1951 he assumed his current position. During the periods 1938 to 1941 and 1948 to 1950, he also taught at Brown University where he was an instructor in machine design in the Division of University Extension. In Providence engineering circles, he is well known for his work in the Providence Engineering Society. He has held elective office as treasurer, vice-president, and president; and in 1943-1944, he was editor of "Engineering." He has been a director of the American Standards Association; and was chairman of the Technical Standards Committee of the National Machine Tool Builders Association. His service to ASME has been extensive. In 1940 he was chairman of the Providence Section. Later, he became a member of the Executive Committee of the Production Engineering Division and, in 1957, served as its chairman. Currently, he is chairman of the Machine Design Division having served on its Executive Committee since 1953. Articles written by Mr. Sizer have appeared in such publications as the *Tool Engineer*, *Machine Design*, *American Machinist*, and MECHANICAL ENGINEERING. He has contributed a section on specifications of dimensions and tolerances to "Kent's Mechanical Engineers' Handbook," Twelfth Edition. A registered engineer in the State of Rhode Island, he holds several patents. He is a member of Sigma Xi.

Ronald B. Smith

RONALD BROMLEY SMITH, a director of The American Society of Mechanical Engineers, is operating vice-president, The M. W. Kellogg Company, New York, N. Y. A registered professional engineer, Mr. Smith began his career in 1930 with Westinghouse Electric and Manufacturing Company. He joined the Elliott Company in Jeannette, Pa., in 1937, where he became assistant chief engineer, then director of research, and finally, from 1945 to 1948, vice-president for engineering and research. Development and application of turbosupercharging to diesel engines, the design of gas-turbine power plants, and the development of low-pressure air fractionation were fields of special interest in which he holds a number of patents. While an engineering vice-president at Elliott, he was also a consultant to the Packard Motor Car Company from 1945 to 1948. In 1948, he went to The M. W. Kellogg Company as director of engineering and, in 1950, took his current post. In 1945, he was a member of the U. S. Naval Technical Mission in the European theatre. Currently, he is a trustee of the New York Trade School, and on the Advisory Board, Research Division, New York University. As an author, he is represented by a number of papers published in the journals of ASME, SAE, SNAME, and The Franklin Institute. Mr. Smith is the recipient (jointly with Dean C. R. Soderberg, Fellow ASME, of M.I.T.) of the 1945 Linnard Prize presented by the Society of Naval Architects and Marine Engineers. He received the Centennial Citation, awarded to a distinguished alumnus, from the University of Michigan in 1953. Mr. Smith is a member of Tau Beta Pi and Sigma Xi; and of The American Petroleum Institute, AIChE, and SNAME. His contributions to ASME are numerous. Since becoming a member, in 1939, Mr. Smith has served on a long list of committees, among them the Standing Committee of Power Test Codes; the Publications Committee, chairman, 1950; the Board on Technology, chairman, 1955; the Finance Committee; and as chairman of the *Applied Mechanics Reviews* Managing Committee. In 1945 he sponsored the Westmoreland Subcommittee of the ASME Pittsburgh Section. Mr. Smith is a member of The Engineers' Club of New York and the Riverside Yacht Club, Riverside, Conn.

Huldreich Egli

HULDREICH EGLI, chairman of the board, Egli and Gompf, Inc., Baltimore, Md., is a specialist in steam-plant design and an outstanding consulting engineer in that field. As evidence of his lifetime of accomplishment, there are hundreds of buildings of all types throughout the State of Maryland in which both design and supervision of construction have been in his charge. Mr. Egli was responsible for the design of the central heating plant at the University of Maryland, in 1930. Since that time, the capacity of the plant has been expanded from 45,000 to 300,000 lb of steam per hour. The flexibility of the original plan has accommodated this growth at the same location, with a minimum of waste of equipment, and a maximum continuation of early planning. Rehabilitation of the 100-year-old Infirmary Building of the Baltimore City Hospitals, a program involving an $8-million expenditure, is another of his credits. A new plant building for Crown Cork and Seal Com-

pany and the utilities systems for Morgan State College are also among his many achievements. Mr. Egli has been a consulting engineer since 1917. Egli and Gompf, Inc., was formed in 1938 with Mr. Egli as president; and in 1954 he became chairman of the board. For almost 35 years he has performed consulting engineering work for the Board of Education of Baltimore County. This work has included nearly all of the existing school structures in the county. He holds several patents; and has done original work in several fields, principal among which are: milk pasteurization, forced classroom ventilation, application of ozone in food storage plants, and many automatic controls for systems. He has, throughout his career, been influential in the training of young engineers in sound and adequate engineering practices. He is a registered professional engineer in the State of Maryland.

James Posey

JAMES POSEY, a partner in the firm of James Posey and Associates, Baltimore, Md., in almost 50 years of consulting engineering work has been responsible for the judicious expenditure of millions of dollars of public and private funds. The scope of his consulting practice has been broad. It has included the design of high-pressure steam plants, steam and hot-water heating, high and low-tension electric work, and such. His work also included the design and layout of special equipment, laundry equipment, utilities, and power plants. He designed high-pressure steam-power plants for central heating, general process work, and electrical generation for service at a number of hospitals in the Baltimore area and in various southern states. His mechanical and electrical designs are used for school buildings throughout Maryland, in Virginia, and in South Carolina. He has designed many telephone-equipment buildings in the Washington, D. C., area and in Virginia; laboratory buildings for the U. S. Bureau of Mines; and the dormitory, classroom, and science building installations at the University of Maryland, Hood College, Washington College, and Randolph-Macon College. He has been responsible for numerous public and Federal housing developments as well as department store installations. He is a registered engineer in the states of Maryland, Virginia, and South Carolina. Mr. Posey is a member of AIEE, the American Society of Heating, Ventilating, and Air-Conditioning Engineers, the American Society of Refrigerating Engineers, and the Illuminating Engineering Society.

J. Carlton Ward, Jr.

J. CARLTON WARD, JR., president, Vitro Corporation of America, New York, N. Y., is an acknowledged authority in the fields of aviation, atomic energy, industrial and engineering management, and education. In aviation, particularly in the development of aircraft engines, he was one of this country's leading authorities. As general manager of the Pratt & Whitney Division, United Aircraft Corporation, 1935–1940, he saw the development of some of the finest engines in the world. Later, as president and then chairman of the board of Fairchild Engine and Airplane Corporation, 1940 to 1950, he managed the development and quantity production of the Cornell Trainer (PT-19) and the Flying Boxcar (C-119). Furthermore, he conceived and led the project of introducing atomic energy into aircraft propulsion (NEPA Project). In the field of atomic energy, too, as president of Vitro, 1953 to date, he is in charge of a company which covers many phases of atomic operations from the mining of uranium to the complete design and operation of finished nuclear facilities. His successes in the area of industrial and engineering management are measured by the growth, under his direction, of both Fairchild and Vitro. In the field of education, as a trustee of Cornell University, he has stimulated the University's engineering prominence. He has been a leader in the development and diversification of the various colleges of the armed forces, particularly the Industrial College of the Armed Forces of which he is chairman of the Board of Advisors. He has been a leader in the movement to guide a larger number of college men into the study of science and engineering. Prior to joining Vitro, he had been chairman of the board, Thompson Industries, Inc., he has published nearly 100 papers, addresses, articles, and other material on aviation, national defense, preparedness, research, atomic energy, and so on. His career has been marked also by participation in technical and professional organizations. Currently, he is director, Atomic Industrial Forum; former chairman of the board, now director of the Flight Safety Foundation; and graduate member of the Business Advisory Committee of the U. S. Department of Commerce. He is a past-president of the Aircraft Production Council; was a director and officer, Aeronautical Chamber of Commerce Aircraft Industries Association; a member of the Eberstadt Committee on National Security Organization of the Hoover Commission for Organization of the Executive Branch of the Government; and a past-chairman, Guggenheim Medal Award Board. He is a member also of SAE, IAS, the Newcomen Society, and Tau Beta Pi and American Association for the Advancement of Science.

Thomas F. Perkinson

THOMAS FRANCIS PERKINSON, manager, Transportation Engineering Division, General Electric Company, Schenectady, N. Y., is recognized for his achievements in railroad-engineering developments. His 34-year career is documented by numerous publications, patents and inventions, and a great many original contributions to railway engineering. Beginning his career as a student engineer on General Electric's Test Course, in 1924, he went on, in 1925, to become design engineer in that company's railway-equipment engineering department. Here he assisted in the design and development of the earliest diesel electric-control systems and diesel electric-motive power. Leaving GE in 1927, he joined the Anglo-Chilean Consolidated Nitrate Corporation, Tocopilla, Chile, S. A., where he supervised installation, testing, and maintenance of industrial-electrical equipment; automatic-electric railway-substation equipment, and the like. In 1928, with Gibbs & Hill, Inc., as construction supervisor, he worked on the electrification of the Pennsylvania Railroad's Philadelphia to Washington System. He returned to General Electric as application engineer in the Transportation Department in 1928, became assistant engineer of the Transportation-Engineering Division in 1947, and manager in 1949. Among his many achievements are the early streamlined designs for electric and diesel-electric locomotives, the design and application engineering on air-conditioning equipment and systems for railroad-passenger cars, and the design of large portable diesel-electric power plants for the U. S. Navy Bureau of Yards and Docks. He is the author of numerous works on railroad engineering, among them are the sections on diesel locomotives and electric locomotives in "Kent's Mechanical Engineers' Handbook," twelfth edition. From 1941 to 1955, he prepared the reports on "Progress in Railway Mechanical Engineering" published in MECHANICAL ENGINEERING. Mr. Perkinson is a registered professional engineer in the State of New York and the Common-

wealth of Pennsylvania. In addition to his duties at GE, he has been a lecturer at the Transportation Institute of the American University, Washington, D. C. His contributions to the Society have been equally distinguished. He has served the Railroad Division as a member and chairman of several committees, and in 1956 was Division Chairman. As such, he initiated the first Railroad Division Conference in April, 1957. Similarly, as chairman of the Professional Division's Committee in 1954, he instituted the Technology Executives Conference. Currently, he is chairman of the Board on Technology and its representative in Council. A member of Sigma Xi, he also holds membership in AIEE and AREA, and is active in committee work in the AAR.

John A. Worthington

JOHN ALEXANDER WORTHINGTON, Manager, Piston Ring and Seal Department, Koppers Company, Inc., Baltimore, Maryland, has been directly responsible for design, development, and the establishment as industry standard of many of today's basic concepts of piston-ring engineering. For 35 years, he has directed the technological development of industrial and aircraft piston and sealing rings for Koppers, which is the largest and technically the most diversified producer of such products in the world. He was responsible for the development of the chrome-plated piston ring and early in World War II, this innovation, by making possible the extension of engine life, met an immediate emergency in North Africa. High-strength malleable iron and steel piston rings, now accepted as standard in all high-speed high-output aircraft and diesel engines, were introduced by Mr. Worthington. He was responsible for the development of and introduction of the high-unit-pressure-ventilated oil ring and the single-piece seal-joint ring, which has been the basis for broad use of piston rings for hydraulic-piston sealing. The multipiece ring combining bronze and cast iron elements now accepted as standard for steam engines was also developed under his management.

As an executive, Mr. Worthington has carefully guided the industry through its developmental period. His career began with Bartlett Hayward Company in 1915, and in 1919 he went to the American Hammered Piston Ring Company, a subsidiary of Bartlett Hayward, as an inspector. In 1927, he was made manager of industrial sales and engineering for the American Hammered Piston Ring Division of the Koppers Company. From 1947 to 1955, he was manager of the Piston Ring Department and he has held his current position since 1955. In the period 1917 to 1919, he served in the U. S. Army and was graduated from the Central Machine Gun Officer Training School. Mr. Worthington has also been interested in diesel-engine development and has written several articles on the subject. He has served the ASME as a member of the Executive Committee, Oil and Gas Power Division, 1952 to 1956; chairman, Oil and Gas Power Division, 1955; and chairman, Meetings and Papers Committee of that Division, 1954. He is a member of the American Society of Naval Engineers and the American Ordnance Association. Mr. Worthington was made a "Fellow" of The American Society of Mechanical Engineers in June of 1957.

George P. Torrence

GEORGE PAULL TORRENCE, retired, formerly professor, School of Business Administration, Emory University, Ga., has had a distinguished career as an engineer, an administrator, and a teacher. By direct participation and by responsible supervision, he has contributed to the design and application of industrial equipment ranging from chains and bearings to complete ore-handling and processing machinery for the continuous manufacture of viscose rayon yarns. Improvements in pneumatic tools for industrial, construction, and mining purposes; landing gear for aircraft, and methods for testing them; all have been achieved with his assistance. At the Ayer and Lord Tie Company, Little Rock, Ark., he began his career as an assistant power-plant engineer, in 1908. After two years, he joined Westinghouse Air Brake Company, Wilmerding, Pa., as a special apprentice. Joining the Link-Belt Company in 1911 as an engineer, he successively held posts as manager of merchandise sales, sales manager, general manager, and in 1932, president. Under his leadership during the depression years, Link-Belt sales tripled. From 1936 to 1944, Mr. Torrence was vice-president and general manager of the Rayon Machine Corporation. In this period, Mr. Torrence and his associates successfully put into operation a revolutionary machine for extruding, processing, and twisting synthetic rayon yarns in a continuous process. As president of the Cleveland Pneumatic Tool Company, 1944 to 1946, he and his associates manufactured aircraft landing gears in previously unheard of quantities for the armed forces. He returned to Link-Belt, as president, in 1946 and remained in responsible charge of its operations until his retirement, in 1952. Upon his retirement, he was invited by Emory University to join the faculty of its School of Business Administration as professor. He taught courses in policy administration and sales management. He retired from Emory in 1957. Mr. Torrence is the author of several articles on engineering and related subjects. He holds ten patents. He has been a member of ASME since 1932 and is a member of the honorary societies, Tau Beta Pi and Beta Gamma Sigma.

Zolly C. Van Schwartz

ZOLLY CARLETON VAN SCHWARTZ, director of engineering standards, The Baldwin-Lima-Hamilton Corporation, Hamilton, Ohio, is an engineer, author, lecturer, and inventor. He was the first individual in this country to publish a complete book pertaining to the test alignment and acceptance standards of all manner of machine tools. Mr. Van Schwartz redesigned the British and Swedish variation of the Bofors 40-mm antiaircraft rifle, making it a fabricated weldment instead of a riveting. This development earned him, in co-operation with J. L. Miller, in 1942, the $11,500 Lincoln Award; and numerous citations from the War Production Board. His career in engineering began with the U. S. Steel Company, in 1929. As assistant to the chief engineer, he joined the National Lead Company, American Bearing Corporation in 1937. He went to the Merz Engineering Company as chief of design and development in 1939; to the British Ordnance Works, Pullman Company, as assistant superintendent in 1940; and to the Firestone Ordnance and Aircraft Company as engineering co-ordinator of design, tooling, inspection, and research, in 1941. Mr. Van Schwartz, in 1945, joined the Peck Stow & Wilcox Company as chief engineer. He assumed his current post in 1947. He is an inventor of mechanical devices, hydraulic components, and tools for war production; and holds over 25 patents on such items. He has written and published a great deal, in addition to the afore-mentioned shop manual, on the subjects of machine tools, production methods, and standards. For nearly 15 years, Mr. Van Schwartz has been on an active lecture tour to promote the interests and the welfare of the engineering profession. He has been selected by the Office of the Secretary of the Army at the request of the Ordnance Weapons Command and the Production Equipment Office to be Expert

Consultant to the Judge Advocate General of the Army, the Contract Board of Appeals, Pentagon. He has been honored by the International and British Standards Organizations for his cooperation in establishing interlocking standards with industry. Mr. Van Schwartz has served for many years on a number of ASME technical committees, subgroups, and sectional committees. He has been elected to membership to the Engineering Institute of Canada, and to the Institution of Mechanical Engineers; he is a member also of SAE, ASTE, ASM, and ASA; currently, he also serves the Technical Standards Council of the National Builders Association. He is a registered professional engineer in the State of Ohio.

Philip M. McKenna

PHILIP MOWRY MCKENNA, president and founder of Kennametal Inc., Latrobe, Pa., is an internationally known engineer, metallurgist, scientist, and monetary economist. At the age of 16, while a student, Mr. McKenna worked part time in the Bureau of Standards' analytical laboratory as a chemist's helper. A year later, during World War I, he was running a tungsten refinery in Giesboro Point on the Potomac in southeast Washington, D. C., as vice-president and general manager. When in 1921, he received his AB degree majoring in chemistry from George Washington University, he had already invented and patented various metallurgical processes. In 1913, he had invented and patented a method of separating nickel and cobalt; in 1916, he had patented the process of separating pure ferrotungsten. During the following years, Mr. McKenna made over 10,000 intricate chemical experiments that culminated in the discovery of a new intermetallic substance—tungsten - titanium - carbide ($WTiC_2$)—the ingredient which made possible steel-cutting carbides now known under the trade name of Kennametal. Patents were granted to him for the several components, the compositions, and the various processes involved. Kennametal is nearly as hard as the diamond and can cut steel in the hardened state at speeds from three to six times faster than with conventional high-speed steel tools. Following five years of private practice as a consultant chemist, Mr. McKenna in 1928 became affiliated with Vanadium Alloys Steel Company, Latrobe, Pa., and in 1932, became research director and vice-president of that company. In 1938 he organized McKenna Metals Company at Latrobe, to manufacture and market his carbide-tool compositions known as Kennametal. Mr. McKenna, a member of ASME since 1941, is also a fellow of the AAAS. He holds membership in the ACS, AIME, ASTE, and the American Academy of Political Sciences. He served for five years as national chairman of The Gold Standard League which he organized. In 1953, as ASME Towne Lecturer, his talk dealt with the return to the gold standard and was entitled, "Economics and the Engineer." In that same year, he was honored by the Society again having been chosen as recipient of the Holley Medal. The award was presented for his "research, development, and application of cemented carbide compositions which have contributed so much to the art and science of metal cutting." In 1955, he was the recipient of the ASTE Engineering Citation. He has written and contributed numerous technical articles on cemented carbides to engineering magazines and trade publications, and has written many articles on monetary economics.

Louis N. Hunter

LOUIS NATHANIEL HUNTER is senior vice-president in charge of engineering and research, National-U.S. Radiator Corporation, Johnstown, Pa. In positions ranging from research engineer to senior-vice-president to member of the board, he has displayed technical competence and effective leadership. He has been responsible for design, development, and testing of the company's line of products—boilers, heat exchangers, convectors, fin tubes, radiators, air-conditioning equipment, and the like. The large number of patents which he holds on related apparatus witness his achievements in this area. Papers and articles written by Mr. Hunter on the subject of heating and fuels have been published in trade journals and the technical press. A listing of the trade associations and professional societies of which he is a member includes: The Institute of Boiler and Radiator Manufacturers, Steel Boiler Institute, Air Conditioning and Refrigeration Institute, the American Gas Association, the American Ordnance Association, the Oil Heat Institute of America, and the American Society of Heating and Air-Conditioning Engineers. He has served each of these groups as an active committeeman. He is a fellow of ASHAE, has been a member of its council, and in 1954 was its president. As a member of the Society since 1936, he served the ASME as a member of the Fuel Division, Program Committee in 1937 and 1938; and has been a member since 1940 of the Boiler Construction Code Subcommittee for Low-Pressure Heating Boilers. Throughout the years he has held a number of government appointments with the Bureau of Standards, the War Production Board, the Civilian Production Administration, the OPA, the National Security Resources Board, the National Production Administration, and the Department of Commerce. He is a registered professional engineer in the Commonwealth of Pennsylvania.

ACTIONS ASME EXECUTIVE COMMITTEE

A MEETING of the Executive Committee of the Council of The American Society of Mechanical Engineers was held in the Society rooms, Oct. 3, 1958. There were present: J. N. Landis, chairman; E. W. Allardt, W. H. Byrne, and L. N. Rowley, of the Executive Committee; Joseph Pope, V. W. Smith, directors; E. J. Kates, treasurer; O. B. Schier, II, secretary; T. A. Marshall, Jr., senior assistant secretary; D. C. A. Bosworth, W. E. Reaser, and S. A. Tucker, assistant secretaries; and Ernest Hartford, consultant. The following actions were of general interest:

ASME Staff Members. Miss Marguerite Marty and Miss Mildred McGuire, members of the staff, were presented to the Committee and assured of the sincere appreciation of their loyal and faithful services and their valuable contributions to the success of the Society.

Functional Plan—Unity of the Profession. The report of the ASME Committee to Review EJC is to be referred to the 1958 Regional Delegates, Section representatives, 1958 RAC meetings, and Section Chairmen as a progress report on Regional Delegates Conference Agenda Item No. 33. With this report will go a copy

of a letter written by President J. N. Landis to E. R. Needles, president, EJC, in which it is stated that the presidents of the five Founder Societies (L. R. Howson, ASCE; A. B. Kinzel, AIME; J. N. Landis, ASME; L. F. Hickernell, AIEE; and G. E. Holbrook, AIChE) had reviewed the report of the ASME Committee and were unanimous in believing that "the really essential part of the report which should be recommended to EJC for consideration is covered by five points" which he presented as follows:

"Recommend to Engineers Joint Council and Engineers' Council for Professional Development that they continue to take the initiative and co-operate in establishing a unity organization to represent the engineering profession by:

(*a*) Taking immediate steps to consummate the consolidation of ECPD and EJC into one organization as early as possible;

(*b*) reviewing and revising, as necessary, the administrative management of the consolidated organization to improve effectiveness, reduce duplication, and increase efficiency;

(*c*) realigning activities and responsibilities of the consolidated organization into three major functional divisions to handle joint educational activities, joint technical activities, and joint professional activities;

(*d*) encouraging NSPE to join the consolidated unity organization so that they may participate, and so that a unity organization may gain from their experience in the professional area;

(*e*) consider changing the name of the consolidated organization to a more descriptive name that aptly describes its character and purpose."

With the Report of the ASME Committee to Review EJC and President Landis' letter will also be sent the following action taken by Engineers Joint Council on Sept. 19, 1958:

"Voted to authorize and instruct the EJC President to communicate by letter to ECPD Planning Committee, approved by the EJC Executive Committee and by the Board, with respect to the establishment of a joint committee charged with the development of a plan for closer affiliation and ultimate bringing together of EJC and ECPD."

Regional Alignment. The Executive Committee voted to revise the ASME Charter to provide that the number of members of the governing body to manage the Society be not less than 22 nor more than 33.

Transactions ASME—Foreign Depositories. For many years the Society has provided a free copy of its *Transactions*, bound, to each of 190 foreign libraries. Rising cost of publication, binding, and mailing, and a belief that some depositories are not being used have resulted in a recommendation of the Publications Committee, which was approved by the Executive Committee, that the present procedure of placing bound copies of the *ASME Transactions* in foreign libraries be abandoned; and that instead, foreign public or educational libraries that satisfy the Society that they are equipped to safeguard the *Transactions*, make them available to the maximum number of readers, and pay a fee of $10 will, for three years, receive the monthly issues of the *Transactions*.

Research Committee. The ad hoc Research Committee on Engineering Administration was discharged with thanks, in view of the termination of the project on which it was engaged.

Awards for 1958. On Sept. 22, 1958, the Board on Honors approved the following awards:

Charles T. Main Award to Frank D. Sams, Clemson Agricultural College, 1959, Clemson, S. C., for his paper, "Student Development of Professional Engineering Attitudes and Ethics."

Undergraduate Student Award to Robert E. Woolcott, Queen's University, 1958, for his paper, "The Measurement of the Components of Front End Alignment."

Old Guard Prize to Harry Hollinghaus, University of Utah, 1958, for his paper, "Changes in the Mechanical Properties of Bone Due to Internally Deposited Radioelements."

Boiler and Pressure Vessel Committee. Approval was voted of the engagement of Elmer O. Bergman to handle the task of consolidation of Code Sections and implementation of new Code Stress Basis.

Custodian Fund. Establishment of a Custodian Fund for the ASME Production Engineering Division was approved.

1958 Regional Delegates Conference. Actions of the Council on each of the Regional Delegates Conference recommendations are set forth in a summary of Council actions. (See pp. 140–141 for complete details.)

Wright and Thurston Lectures. Joseph W. Barker will deliver the Roy V. Wright Lecture at the 1958 Annual Meeting. Upon recommendation of the Machine Design Division, the Meetings Committee, and the Board on Technology, the Executive Committee approved the invitation to Dr. R. A. Beyer, professor, Technische Hochshule, Munich, and visiting professor in kinematics and mechanisms, Columbia University, to deliver the Thurston Lecture at the 1958 Annual Meeting.

Certificates of Award. Certificates of Award were granted to: B. H. McDaniel, Northeast Florida Subsection; D. E. Marlowe, Washington, D. C., Section; E. Miller, Northern Jersey Subsection of Metropolitan Section; W. F. Kopf, Mid-Jersey Section; E. D. Spina, Mid-Hudson Section; R. Vitolo, Long Island Subsection of Metropolitan Section; J. W. Sawyer, chairman, Washington, D. C., section (1953–1954).

United Engineering Center. The Secretary submitted a report on behalf of W. F. Ryan, chairman, ASME Member Gifts Committee, who was unable to be present. Charts were displayed indicating (*a*) the relationship of the average gift in dollars to the total number of donors for each of the five Founder Societies, and (*b*) rate of giving for each of the five societies since June, 1958. Since the meeting of the Executive Committee of the Council on Sept. 5, 1958, ASME, with pledges of $116,500, has moved to third position behind ASCE with $124,000 and AIEE with $155,000. The increased rate of pledging by ASME is undoubtedly due to the nationwide organization planned in the spring and developed during the summer, which is now aggressively soliciting members in 60 of the 86 Sections of the Society.

All vice-presidents have reported increased activity in most of their Sections. At the request of four vice-presidents, staff members will meet with the Member Gifts Committees in San Francisco, Los Angeles, San Diego, St. Louis, Chicago, Detroit, Mid-Hudson, and Metropolitan Sections.

The Waterbury, Conn., Section is the first to exceed its quota due to the efforts of John Melville, chairman of the Section Member Gifts Committee. Mr. Melville, by following the instructions provided to all Sections, contacted the "A" or top prospects *first*, was a good listener, and then tactfully but firmly presented the data given in the brochure, and received one pledge amounting to 98 per cent of the Section quota.

Engineers Joint Council. The Executive Committee, May 2, 1958, discussed creation of a National Transportation Policy and recommended that EJC undertake a major study looking toward the development of a National Transportation Policy covering air, water, rail, etc. After considering this recommendation EJC requested nominations from ASME and other societies from which it will select a group of qualified individuals representing the profession, probably not more than ten. The Executive Committee nominated persons in the categories of Airlines, Private Air Travel, Railroads, and Shipping.

Joint Awards. The following awards in

which the Society participates were made in 1958:

Herbert Hoover Medal: Lt. Gen. Raymond A. Wheeler, USA (Ret.), Washington, D. C.

Elmer A. Sperry Award: Dr. Ferdinand Porsche (in Memoriam); Dr. Heinz Nordhoff, Wolfsburg, Germany.

John Fritz Medal (1959): Mervin J. Kelly, New York, N. Y.

Daniel Guggenheim Medal: William Littlewood, Washington, D. C.

Wallace Clark Award: Harold F. Smiddy, New York, N. Y.

Washington Award: Ben Moreell, Pittsburgh, Pa.

Freeman Fellowship: Alexander B. Rudavsky, Teheran, Iran.

Death. The Executive Committee noted with regret the death on Sept. 23, 1958, of Thomas R. Weymouth, Vice-President, ASME, 1930–1932.

Presidential Appointments. The following presidential appointments were reported:

Tellers of Election 1959 Officers: R. W. Cockrell, John de S. Coutinho, E. Paul Lange

Sixth International Congress on Large Dams, New York, Luncheon, September 18, 1958: William H. Byrne

Lafayette College, Easton, Pa., Inauguration of President, October 23, 1958: Arthur W. Weber, ASME Vice-President, Region III

University of Maine, Orono, Maine, Inauguration of President, October 24, 1958: Harry D. Watson

ECPD Annual Dinner, St. Louis, Mo., October 9: John K. Bryan

American Institute of Consulting Engineers, Annual Dinner, New York, October 14, 1958: H. V. Coes

ASME Council Actions on 1958 National Agenda Reported

How the National Agenda Is Compiled for Regional Administrative Committees and Items Which Are Ultimately Acted Upon by Regional Delegates Conference

At a meeting of the Executive Committee of the Council of The American Society of Mechanical Engineers, held at Society Headquarters, New York, N. Y., on Oct 3, 1958, approval was voted of statements and actions on the recommendations of the 1958 Regional Delegates Conference submitted to the Council at the 1958 Semi-Annual Meeting, Detroit, Mich., June 16, 1958.

These recommendations, the actions of the Regional Delegates Conference on them, and the actions or statements of the Council are reported in what follows. A detailed description of the procedure by which agenda items are prepared and acted upon by the Sections, the Regional Administrative Committees, the Regional Delegates Conference, and, finally, the Council follows the report on the 1958 recommendations.

Final Report on 1958 RDC Recommendations

Agenda Topic No. 18: Improve Availability of Power Test Codes: It is proposed that the availability of copies of Power Test Codes be improved.

Delegates' Action: APPROVED 15-0.

Council Action: The Council on Oct. 3, 1958 concurred in the action taken by the Power Test Codes Committee on Sept. 23, 1958, namely: (1) to instruct staff to confer with the chairman of each cognizant technical committee and the chairman of the Power Test Code Committee regarding the advisability of either revising or reprinting an existing test code or an instruments and apparatus supplement; (2) if revision is to be made to mark all existing stock copies "Under Revision"; and (3) to maintain copies in stock by reprinting when necessary.

Agenda Topic No. 27: Eliminate transfer fee from Associate Member to Member: It is proposed that the fee for transferring from Associate Member to Member Grade be eliminated.

Delegates' Action: APPROVED 11-4.

Council Action: The Council on Sept. 5, 1958 (#271) referred to the Constitution and By-Laws Committee for inclusion in the next constitutional change submitted to the membership for approval, the discontinuance of the "Promotion Fee from Associate Member to Member or Affiliate Grade" (Article C5, Section 1).

Agenda Topic No. 33: ASME co-operates in assigning tasks to various unity organizations: It is proposed that ASME co-operate with the other engineering societies in promoting a unified engineering profession by assigning to EJC, ECPD, and NSPE the general scope of duties as outlined in the report to AIEE members by Mr. M. S. Coover, president of AIEE, which was reprinted in the July, 1957, issue of Mechanical Engineering.

Delegates' Action: APPROVED 13-1.

Council Action: The Council concurred in the recommendation of the Organization Committee on Oct. 2, 1958, that the action of the Executive Committee on September 5, 1958, regarding the "Report of the ASME Committee to Review EJC" be referred to the 1958 Regional Delegates, Section representatives, 1958 RAC meetings and Section Chairmen as a progress report on RDC Agenda Item #33. The report is to be accompanied by President J. N. Landis' letter of Sept. 4, 1958, to E. R. Needles, President of Engineers Joint Council, and the action of Engineers Joint Council taken on Sept. 19, 1958.

Agenda Topic No. 38A: ASME co-operate with other Societies in promoting education of Engineering Aid: It is proposed that ASME publicly and actively support with EJC and other engineering societies a national program publicizing the Technical Schools or Institutes which in eighteen months or so can provide a person with sufficient technical training in a specialized field to enable him to hold down a semiprofessional position similar to that presently called an Engineering Aid. Further, that ASME educate industry to the benefits available in using this talent. The program should be directed toward the high-school graduate or tradesman who does not want to or cannot afford to study for a college degree.

Delegates' Action: APPROVED 11-3.

Council Action: Awaiting recommendation of newly created Board on Education which is scheduled to meet for the first time on Oct. 15, 1958, in Ann Arbor, Michigan.

New Business: Rejection of Item 26-14.30.1 Realignment of Regions by a vote of 8-7 resulted in the following recommendation:

"The Charter be amended to provide an increase in the number of members of Council, in order to permit the organization of additional Regions."

Delegates' Action: APPROVED 12-2.

Council Action: On recommendation of the Organization Committee, the Executive Committee on Oct. 3, 1958 (#305), voted to revise the ASME Charter to provide that the number of members of the governing body to manage the Society be not less than 22 or more than 33.

Items Rejected:

To complete the record, the following items that appeared on agenda for the Regional Delegates Conference were rejected: No. 2A—10.14.3, No. 26—14.30.1, No. 28—16.12.2, No. 34—19.15.1.

ASME Procedure in Preparing and Discussing Agenda Items

THE American Society of Mechanical Engineers has developed a procedure whereby action is taken by all Sections on suggestions made by any Section to improve policies, procedures, and operations of the Society. This procedure starts with the compilation by the National Agenda Committee of preliminary statements of the items suggested. If one third of the Sections approve any one item, it is included in a National Agenda for discussion at Regional Administrative Committee meetings held in the spring.

Further discussion at a national level takes place at the Regional Delegates Conference held during the Semi-Annual Meeting. The results of this Conference are then submitted to the Council.

The principal business of the Regional Delegates Conference held during the Semi-Annual Meeting is to consolidate the actions of the eight RAC meetings on the National Agenda and to report the consolidated view to the Council. Related matters frequently arise on which a consolidated view is developed, or on occasion the Council may request the opinion of the RDC on a Society policy or procedure. The Council is usually in session at the same time as the RDC and provision is made for the Delegates to attend the Council Meeting.

A report of the actions of the Conference is made to Council during the Semi-Annual Meeting. The Council after studying the recommendations of the RDC refers to the various administrative agencies of the Society the different items with which those agencies are concerned.

After considering comments received from the administrative agencies, the Council acts on the recommendations of the RDC. These actions were reported to the Delegates and Section Executive Committees on Oct. 20, 1958. Thus the cycle from origination of items by the Sections to a reporting of actions by Council is completed within one year.

Compilation of the National Agenda

About September 1 of each year, the chairman of the Agenda Committee sends forms to the Sections and requests the submission of items by the end of October.

Upon receipt of the items, the Agenda Committee reviews them, corresponds with the suggesting Section, and refers the items that can be dealt with promptly as administrative matters, to the proper administrative agency.

On December 19, a compilation of all items accepted by the Agenda Committee will be sent to the Sections for an expression of opinion as to inclusion in the final agenda. By February 2, 1959, the Agenda chairman must have all the opinions. One third of the Sections must approve an item before it can become a part of the National Agenda, which is sent out to all the Sections at least four weeks in advance of the first RAC meeting.

Action in the Sections

The National Agenda requires action in the Section Executive Committee on at least three points:

A In the original suggestion of items. In this process it is desirable to canvass member opinion by some method, by mail, or at a Section meeting.

B The expression of opinion about including an item in the National Agenda.

C A determination of the position the Section is to take on the items in the National Agenda.

It is generally desirable for the Section to select its representatives to the RAC meeting at an early date so that they may be in touch with the entire process of developing the National Agenda.

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

THESE items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 per cent of the first year's salary if a nonmember, or 4 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for nonmembers, payable in advance.

NEW YORK
8 West 40 St.

CHICAGO
84 East Randolph St.

SAN FRANCISCO
57 Post St.

Men Available[1]

Chief Engineer, BSME; 37; 17 years in design, development, and manufacture of products, tools, and special machinery. Employed in electrical connectors, design, and manufacture; responsibilities include engineering personnel, design, methods, and all technical liaison. Will relocate. Prefers East, South. Me-657.

Project Engineer, BSME, MAEE; 24; three years' experience, test and development, layout and design, for major automotive firm. Present position, project engineer of styling group. Duties include preliminary design and engineering, technical adviser, liaison to engineering. Prefers East. Me-658.

Industrial Management Engineer, BSIE; 31; five years' experience in industrial engineering including cost reduction, manufacturing engineering and supervision. Prefers Northeast. Me-659.

Cost-Reduction Engineer, BME, BS Management; 35; 12 years' application of engineering to reduction of costs in metalworking and chemical industries. Major fields, materials handling, air conditioning, mechanical design. Prefers Northeast, but will go anywhere. Me-660.

Mechanical Engineer, BME; 25; married; no children; desires overseas employment. Me-661.

Chief Engineer, BSME; 37; 12 years' experience in design and supervisor of design of heavy machinery. Oil field and sawmill. Four years as chief engineer. Registered PE. Location optional. Me-662-911-Chicago.

Field-Service Engineer, BME, MAeE; 39; former chief engineer of leading Latin American airline, broad technical and administrative experience. Also teaching experience at university level. Languages: English, Spanish, and French. Desires field service, technical representation for company affording future and opportunity. Prefers South America. Me-663.

Instructor or Professor, MS(ME) Yale, BSME Purdue; 49; industrial engineering or industrial management; two years as dean of College of Engineering, Addis Ababa, Ethiopia; one year as assistant professor same college; 13 years as plant engineer. Prefers East or Middle West. Me-664.

Mechanical Engineer, BSME; 60; consulting engineer—mechanical, heating, air conditioning, plumbing and refrigeration, and industrial management time study and cost control; 40 years' experience. Prefers Ann Arbor, Detroit area. Me-665.

Plant Engineer, BSME; 53; more than 20 years' experience in all phases plant engineering

[1] All men listed hold some form of ASME membership.

and construction. Excellent references. Available January, 1. Me-666-913-Chicago.

Industrial Engineer, BS Applied Science, postgraduate Industrial Engineering; 33; varied experience in industrial engineering, accounting, cost analysis, transportation, market analysis, and planning. Desires staff position with challenging growth opportunity. Prefers East or Midwest. Me-667.

Project Plant Engineer, BSME; 40; 18 years process and plant design, specification, estimate, supervision of plant projects with chemical companies. Prefers Middle Atlantic States. Me-668.

Research Engineer, MSME; 28; five years research-theory; testing: methods, equipment, setting up test programs; data analysis, mathematics; program small punch-card computer. No military work acceptable. Prefers San Francisco Peninsula; will relocate but not to Los Angeles or South. Me-231-San Francisco.

Positions Available

Mechanical Engineer, Machine Designer, BME degree or equivalent experience. Should have three to five years' experience in design of high-speed, precision-production machinery. Must be able to carry out design investigations and follow projects through the design, development, and production states. New ideas are required to create machinery for mass production of electronic components. Salary in line with applicant's experience and capabilities. Northern Pa. W-6566.

Mechanical-Electrical Supervisory Engineer to oversee power plants, electrical installations, shops, and machinery of established mining and milling company. Must have knowledge of steam-turbine power plants. Good living conditions. Salary open. Mexico. F-6606.

Transacter District Specialist, college background or equivalent in liberal arts, accounting, marketing, or engineering, minimum of four years' successful office-equipment industry experience, systems-sales, or field technical work, particularly punched-card, computer, and integrated data-processing communications, field technical sales, or supervisory experience. Experience in selling and actually installing comprehensive computer or punched card production control, inventory, and pay-roll applications is highly desirable. Will co-ordinate activities pertaining to transacter sales within territory. $7500–$8500. Company pays placement fee. Extensive travel; must be willing to locate in Chicago, New York, Los Angeles, or Conn. Headquarters, Conn. W-6607.

Assistant to Product Planning Manager, graduate mechanical or electrical, with courses in design, production planning and control, accounting, and economics; minimum of six years' manufacturing experience, preferably in office equipment or allied industry; minimum of four years of co-ordinating and expediting experience; technical report and instruction writing experience is essential. $8000–$10,000. Company will pay placement fee. Conn. W-6608.

Project Plant Engineer, mechanical graduate, approximately five years' experience as project engineer or plant engineer in the paper converting or boxmaking industry. Will recommend material-handling equipment, install new equipment, handle waste disposal, etc. To $9000. Ohio. W-6629.

Section Leader, seven to ten years' experience in manufacture and design of electromechanical equipment. $10,000–$12,000. Upstate N. Y. W-6631.

Product Designer, graduate, five to ten years' experience in product design of small electromechanical devices. Will be in charge of special project redesigning small electric motors and consumer household products. $9000–$10,000. Conn. W-6637.

Teaching Personnel, rank of assistant professors, instructors, and part-time graduate assistants in engineering mechanics for both teaching and research. Excellent opportunities for graduate study. Positions available in February, 1959. Pa. W-6644.

Senior Mechanical Engineer, graduate–mechanical, minimum of three years of machine designing experience, industrial and mechanical experience consisting of rolling mills or fabricating plants. Will carry out mechanical-engineering projects in plant involving designing alteration and installation of machinery and equipment primarily in rolling areas. $8580–$11,400. South. W-6646.

Market Research Engineer, BSME or BSEE, minimum of two years' sales engineering or marketing experience; technical product promotion experience. Experience in selling electronic, hydraulic, or pneumatic instruments, automatic controls or test equipment highly desirable. Will be responsible for gathering and analyzing data relative to existing and potential military and commercial markets. About $10,000–$12,000, and profit sharing. Agency fees and relocation expenses will be negotiated. N. Y. State. W-6649.

Administrative Executive, mechanical graduate, to take charge of the production and industrial engineering for a process industry including maintenance. Knowledge of costs and labor relations desirable. Will become either factory manager or vice-president of production. About $15,000. New York, N. Y. W-6657.

Product-Development Engineer to design, develop, write specifications for metal partitions, wall panels, library shelving. Will report to vice-president of sales. $10,000–$12,000. South. W-6658.

Chief Mechanical Engineer, mechanical graduate, at least ten years' structural, plate, and equipment experience, to design wind tunnels and test cells, prepare specifications and supervise projects. $12,000–$15,000. East. W-6661.

Associate Professor, Industrial Engineering, MS degree required, PhD preferred, to teach industrial-engineering courses and assist in the development of a graduate program. Should have teaching or industrial experience with a basic understanding of statistics and probability theory as applied to industrial-engineering problems. New England. W-6662.

Manager of Engineering, mechanical graduate, engineering, executive, and managerial experience covering all phases of design, product, and manufacturing engineering in aircraft power plant or allied fields. $20,000–$30,000. East. W-6666

Manufacturing Engineer to plan manufacturing operations and estimating cost of medium-sized precision-machined and welded assemblies, for either military or commercial applications. $8400–$9600. Ohio. W-6669.

Process Engineer, engineering training and three to ten years' manufacturing experience including process, analysis, quality improvement, methods, production, and cost reduction of electronic components covering capacitors, resistors, or printed circuits. Security clearance required. $7000–$9000. Pa. W-6675.

Chief Engineer, five to ten years' central station experience. Must be capable of taking responsibility for operation and maintenance of steam-generating plant. Salary open. Peru. F-6679.

Manufacturing Engineer, ME degree, at least six years' industrial experience, to supervise a section of heavy industrial manufacturing engineering department; will be responsible for processing, tool design, machine tools, and cutting tools. Broad background concerning machine-tool capabilities or potentials and general knowledge of manufacturing and engineering operations. $8000–$10,000. Upstate N. Y. W-6688.

Industrial Engineer, manufacturing experience covering time study, work measurement, wage incentive, production methods, and production control. Must be free to travel and relocate. $8000–$10,000. Headquarters, New York, N. Y. W-6691.

Project Engineer, at least three years' mechanical design experience, to set up an engineering department for a company manufacturing concrete and mortar mixers, paving machinery; contractors fork-lift trucks and machinery for earth and rock-tunneling operations. Salary open, plus fringe benefits. Wis. W-6693.

Product Engineer, ME or EE graduate, 20 years' experience designing small electromechanical devices as end products. Should have proved background in application of engineering principles to product development. Company manufactures automotive accessories and household appliances. $12,000–$15,000. Conn. W-6694.

Burner Designer, engineering degree, to design, supervise initial fabrication, and test a complete line of gas and oil burners. $5000–$10,000. Ohio. W-6695.

Engineers, BSME or BSEE, graduate degree desirable, one to three years' experience in product development, research, or prototype production of small precision instruments or aircraft components. (*a*) Product-improvement engineer to enter a product-improvement group to run evaluation tests to determine deficiencies in product performance and devise and demonstrate improved designs and techniques. (*b*) Prototype-design engineer to study and negotiate valve specification through sales with customer. Specify prototype valve design. (*c*) Production engineer to assume responsibility for elimination of technical problems encountered in test and assembly of complex electrohydraulic valves. Determine test equipment and procedure. (*d*) Reliability engineer to derive, conduct, and report results of tests which determine degree of reliability of a product or subassembly design on the customary missile-aircraft environmental regimes. Should be experienced in environmental test circuitry and strong on instrumentation judgment. To start, $8000–$10,000. Company will negotiate placement fees and relocation expenses. Upstate N. Y. W-6703.

Mechanical Engineer, preferably with MSME but BSME with extensive experience is acceptable. Training in machine design with emphasis on applied kinematics required. Will direct technical supervision over all mechanical design and production release work. Experience should include three to five years' minimum of design and development work on electromechanical devices typical of office-equipment machinery. $8000–$12,000. Company pays placement fees. Conn. W-6706 (*a*).

Engineers. (*a*) Design engineer, ME degree, interested in and qualified for circuit design in high-pressure oil hydraulics field. Must be experienced in machine design; knowledge of oil hydraulic field. (*b*) Design engineer, preferably with ME or EE degree, at least four years' experience in servomechanisms. Must know and understand use and relationship to high-pressure oil hydraulic pumps. (*c*) Valve designer, high-pressure oil hydraulics, low-leakage spool-type valves. Must be experienced in this field. Engineering degree desired. Salaries open. Company pays placement fees. Conn. W-6710.

Development Engineer, graduate mechanical, applied mechanics, or machine design major; about eight to 12 years' experience in the steel industry, related to the operation and maintenance of continuous rod, merchant, and billet mills. Work will include analysis, engineering, and test work; production design, etc. Company manufactures continuous rolling mills and allied equipment for steel industry. About $10,000. Northeastern U. S. W-6711.

Engineers. (*a*) Hydraulics test laboratory supervisor, graduate mechanical or aeronautical, some experience in hydraulics and/or test engineering in the aircraft-missile field required. Will supervise staff of technicians in arranging for equipment and conducting tests of aircraft hydraulic components and systems. $7200–$9600. Northern N. J. (*b*) Product engineer, castings design and application, graduate mechanical, four to ten years' experience in design and/or plant engineering. Experience in steel-mill maintenance involving bearing maintenance desirable; also knowledge of heat flow (heat conductivity of metals). Will study customer requirements and redesign castings to improve operating characteristics; redesign of tuyères through application of heat-transfer theory. $7200–$9600. Western Pa. W-6713.

Administrative Engineer, mechanical graduate, at least ten years' office-engineering experience covering preparation of reports, specifications, standards, and application of residential heating equipment. $10,000–$12,000. New York, N. Y. W-6724.

Sales Engineer, engineering degree or equivalent, five years' sales experience, to sell heat-transfer equipment and distillation columns to the chemical and petroleum industries. Production and/or engineering experience in allied equipment desired; must have knowledge of heat-exchanger design. Sales contacts in the Midwest. Travel about 60 to 70 per cent of time. Territory, entire Midwest. W-6725.

Trainees, graduate mechanical or civil, for multiplant operation for the manufacture of cement, lime, refractory, and related products. About $6000. Midwest. W-6729.

Research Mechanical Development Engineers, with Doctor's or MS degree and at least five years' experience, to be responsible for fundamental and applied investigations in petroleum, chemical, and metallurgical fields. (*a*) Senior research engineer, combustion specialist, mechanical, chemical, or aeronautical engineer, with emphasis on combustion processes or combustion devices, i.e., applied research and development. (*b*) Senior research engineer, heat and mass-transfer specialist, mechanical or chemical engineer, development work in industrial applications such as spray drying, heat exchangers, thermal machines, two-phase heat transfer, etc. (*c*) Senior research engineer, fluid-flow specialist, mechanical or chemical engineer, background in such industrial applied development as fluidized flow techniques, fluid dynamics of two-phase flow, etc. (*d*) Senior research engineer, mathematics, physics specialist, at least ten years in industrial organization with demonstrated aptitude for assisting in solution of applied development problems. Background in fluid mechanics, heat transfer, thermodynamics, nuclear energy, etc. desired. (*e*) Supervisor, mechanical research, mechanical or chemical engineer, sound background in experimental techniques, instrumentation, analysis, and engineering reports. (*f*) Mechanical engineer, graduate, experience in stress analysis, design, fabrication development. $10,000–$13,000. New York, N. Y. W-6730.

Product-Development Engineer, graduate mechanical or metallurgical, at least three years' experience. Design or redesign wide variety of valves, operating mechanisms, and component parts. Variety of calculations such as strength of materials, volume, capacity of flow and pressure drop. Select materials of construction. Select or recommend purchased items for inclusion in design. Co-operate with laboratory in testing. Check work of draftsmen and detailers. Service calls to check performance of product and secure information affecting design of product. Will

work on nuclear development and adaptations in valve industry. About $7100. Employer will negotiate placement fee. South Chicago area. C-7062 (*b*).

Machine Designer, graduate mechanical, at least five years on the board on high-speed automatic machine design. Will supervise three machine designers and two draftsmen plus a machine shop of approximately 30 on high-automatic machine design and development for a manufacturer of canmaking machinery. Salary open. Employer will pay placement fee. Southern Wis. C-7089.

Mechanical Design, Rolling Mills, three to five years' experience on heavy machinery, preferably rolling mills, for modification and new designs under direction of plant engineer. Must be willing to work board 50 to 70 per cent. $7200–$8400. Employer will negotiate placement fee. San Francisco Peninsula. S-3903.

Designer, Tape Recorders, mechanical graduate, capable of designing mechanisms and packaging for tape recorders. Experience with this type of product is essential. To $9600, depending upon qualifications. Employer pays placement fee. San Francisco Peninsula. S-3927.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after Dec. 25, 1958, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

Alabama

NOLAN, THOMAS H., Mobile

Arkansas

BRITTON, RICHARD E., Pine Bluff

California

•BUCHBERG, HARRY, Los Angeles
•DAVIS, BRUNO A., San Francisco
DIXON, KENNETH K., Los Angeles
DOBLER, LELAND R., Vallejo
EVANS, HENRY P., Alhambra
FARRELL, CHARLES W., Garden Grove
HALL, ROBERT W., Los Angeles
•JONES, AUBREY H., Anaheim
•MATTHEW, PAUL, Walnut Creek
ROHR, LEONARD C., Los Angeles
•SHIELLS, DANIEL A., San Carlos
VISSER, RICHARD K., Palm Springs

Colorado

TALBOT, JOHN D., Denver

Connecticut

HOOD, DONALD M., Devon
NEOU, CHING-YUAN, Bridgeport
POTTER, ALLEN C., Harwinton
WAMBACH, THEODORE J., New London
•WILLIAMS, JAMES R., Stamford

Delaware

•AU, TIN Y., Wilmington
PENOZA, FRANK J., Wilmington

Florida

FULLER, RALPH A., Pensacola
HUANG, T. C., Gainesville
MULDOWNEY, THOMAS F., Panama City

Georgia

•ENDSLEY, JOSEPH W., Atlanta

Hawaii

LANGE, WILLARD A., Honolulu
LEE, EDWARD K., Honolulu

Illinois

BASINSKI, LEONARD R., Chicago
BUSH, THOMAS L., Chicago
ESCHBAUGH, JOHN T., Decatur
HAVEL, FRANK S., Brookfield
•MEYER, ROBERT W., Pecatonica
NEIMAN, ROBERT A., Chicago
REDER, RONALD E., Franklin Park
SPRINGINGS, DONALD G., Lockport
•WATTERS, RAY B., Mt. Prospect

Indiana

RAMSBEY, GENE S., Mishawaka
RAYMANN, CARL A., Indianapolis
TEMME, LOWELL G., Indianapolis

Kansas

BROWN, GERALD G., Wichita
HOBBS, EDWARD V., Wichita
•KIMBL, WILLIAM R., Manhattan
MONTRE, LOUIS G., Wichita

Kentucky

LOFTON, WILLIAM H., Paducah
•RODABAUGH, EVERETT C., Louisville
SHELTON, RUSSELL S., Paducah

Louisiana

•SMITH, SPENCER G., New Orleans
STRAVOLEMOS, EMANUEL, Shreveport

Maryland

ADAMS, RALPH L., Baltimore
LEES, ALDRIDGE L., Baltimore
STEVENS, CLARKSON G., JR., Catonsville
TENGSATER, TORSTEN N., Takoma Park

Massachusetts

BOROWSKI, LUDWIG T., Cambridge
•CALDERARO, EUGENE, Springfield
HAWTHORNE, HERMAN F., Wilbraham
KARCHER, HERBERT R., Melrose
KOHN, ARTHUR O., West Lynn
•MOLINO, NINO M., Belmont
NUGENT, JOHN J., Braintree
PERKINS, ROBERT E., Quincy

Michigan

ASERITIS, VIKTORS, Midland
CLARK, CLARENCE H., Belleville
FOCO, EUGENE E., Jackson
GRIFFITH, CLIFTON H., Detroit
HUELLMANTEL, LOUIS W., Detroit
PARKER, DONALD, Royal Oak
QUAIL, ROBERT T., Detroit
RYDER, DAVID A., Bay City
WAGNER, ROBERT J., Highland Park

Minnesota

MILLIN, JAMES W., St. Paul
SUTHERLAND, WILLIAM J., Minneapolis

Mississippi

IWAMASA, CHARLES T., Pascagoula

Missouri

BERRY, JOHN L., Ferguson
MORRIS, CHARLES T., St. Louis
•WEIGEL, MARION J., Kansas City

New Jersey

BACHMAN, WILLIAM H., Elizabeth
FISHER, HENRY C., Packanack Lake
•HOTTENSTINE, RICHARD D., Hillsdale
•ROSS, RICHARD H., Morristown
WARNER, RALPH E., Fanwood

New Mexico

MCLAIN, JOHN P., Socorro

New York

•COTHREN, JACK, Schenectady
DEDIVITIS, JOHN D., Yonkers
•DERBSIEWICZ, HERBERT, New York
•DHANAK, AMRITHAL M., Troy
EDWARDS, JOHN A., Beacon
ELLETT, ROBERT C., Corning
EMBLEY, KENNETH F., East Meadow, L. I.
FELDMAN, NORMAN N., Utica
GALKA, ALEXANDER J., Bayside, L. I.
•GRANET, IRVING, Wantagh
GUENTHER, WOLFGANG P., New York
HOLMES, ROBERT G., Niagara Falls
JOHNSON, GILBERT K., Corning
•JOHNSON, MILO A., JR., Owego
LEEDS, BENJAMIN L., East Northport
MCCLIVE, JOHN R., Buffalo
MEIKLE, ROBERT L., Corning
MICHEL, RENÉ P., Troy
PARMENTER, WARREN G., New York
RANDALL, KENNETH P., Niagara Falls
•RAYBURN, WALKER H., Wellsville
•SCHATKUN, PHILIP, Brooklyn
SHAMSY, ZIAOLLAH, Rochester
SONDEREGGER, HANS H., Hudson
•TINGLEY, DONALD J., Corning
TODA, NORMAN F., Westbury

North Carolina

LONDON, JOHN B., Charlotte

Ohio

•DEISSLER, ROBERT G., Fairview Park
EESLEY, DANIEL E., Barberton
HEFFERAN, JOHN K., Alliance
HOFFMAN, GEORGE E., Garfield Hts.
KALLIN, INGMAR N., Cincinnati
•KEINATH, GERALD E., Columbus
•LEE, TOY F., Columbus
MUSAT, GEORGE, Canton
NAGY, ARTHUR L., Cincinnati
SKINNER, SELBY M., Willoughby
SMITH, RUSSELL G., Cincinnati
SPEICH, CARL F., Columbus
SPRINGER, WILLIAM E., Springfield
TERRANO, PAUL P., Shaker Hts.

Oklahoma

•TUMILTY, JACK E., Tulsa
WINN, FRED M., JR., Tulsa

Pennsylvania

BARTH, EMMA C., Pittsburgh
BRONDER, WILLIAM M., Pittsburgh
BRUGGER, FRANK L., Latrobe
CHEEMA, HARBANS S., Pittsburgh
CLOUD, ROBERT L., East Pittsburgh
•DORWART, KENNETH G., Lancaster
HARRIS, TEDRIC A., Pittsburgh
•HERDER, MAGNUS C., Pittsburgh
HEREDA, FRANK D., New Kensington
HOGLUND, LESLIE E., Creighton
•KREITH, FRANK, Bethlehem
•KUHN, EARL C., Verona
PANTANO, SAVERIO A., McKees Rocks
PINSON, JOE L., East Pittsburgh
POTESTÁ, ARDUINO M., Pittsburgh
•REED, CHARLES W., Philadelphia
ROBERTS, DONOVAN E., Drexel Hill
STILLER, BERTRAM H., Erie
•VAUGHAN, ROBERT T., Cheltenham
VERCHUK, PETER W., Philadelphia
WHITE, DOUGLAS F., University Park
•WILLIAMS, JOHN C., JR., Plymouth Meeting

Rhode Island

KORMOS, KALMAN, North Scituate

South Carolina

CHRISTY, WILLIAM O., North Augusta
HEYSE, HERBERT W., Columbus

Tennessee

SMITH, ROBERT H., Signal Mountain
VOGELSANG, CARL W., JR., Donelson

Texas

BEHNKEN, ROBERT W., Houston
•DRAKE, LEE A., Dallas
FISCHER, FRANCIS H., Corpus Christi
LUCKY, MAURICE C., Houston
SAFRAN, STEPHEN J., San Antonio
ST. JOHN, RICHARD B., Texas City
•THAYER, KEITH B., Houston

Washington

HALLEEN, ROBERT M., Pullman
NELSON, RALPH L., JR., Spokane

West Virginia

•MOORE, WILLIAM, II, Charleston

Wisconsin

STONE, HARRY B., Beloit

Foreign

•ARMSTRONG, JOHN L., Nobel, Ont., Canada
•BROWN, JAMES A., Toronto, Ont., Canada
DEANUZITA, GOTZON A., Mexico, D. F., Mexico
DEEGAN, JOSEPH L., Ascot Vale, Melbourne Victoria, Australia
HIDALGO, ENRIQUE, Caracas, Venezuela, S. A.
LEITCH, JOHN D., Willowdale, Ont., Canada
PANI, NARASIMHA R., Basavanagudi, Bangalore, S. India
PAPASOTIRIOU, SPYROS S., Athens, Greece
PAPASTAVROU, PAUL T., Aliverion, Euboea Is., Greece
•SEEDORFF, WILLIAM A., JR., Esterhazy, Sask., Canada

• Transfer to Member or Affiliate.

OBITUARIES

Thorkild Avnsoe (1884–1958), director and former executive vice-president, Lone Star Cement Corp., Port Chester, N. Y., died Sept. 9, 1958. Born, Copenhagen, Denmark, Aug. 24, 1884. Education, Technical Institute of Copenhagen, 1905. Jun. ASME, 1913; Assoc.Mem. ASME, 1916; Mem. ASME, 1922. Mr. Avnsoe was a designer of cementmaking machinery and cement plants. Survived by his widow, Emma Wicks Avnsoe; a son, Arthur; and a daughter, Mrs. Laurine Ulmer.

William Stewart Ayars (1873–1958), consulting engineer and retired professor of industrial engineering, Columbia University, New York, N. Y., died Aug. 23, 1958. Born, Wilkes-Barre, Pa., Oct. 28, 1873. Parents, Charles Evans and Sallie E. (Stewart) Ayars. Education, ME, Lehigh University, 1896. Married, Laura A. Porter, 1901. Mem. ASME, 1913. Mr. Ayars had served in the U. S. Navy during the Spanish American War. He began his teaching career at Pratt Institute in 1901. In 1905, he went to The Pennsylvania State College; in 1911 to Nova Scotia Technical College; and in 1922 he joined the faculty at Columbia. He retired in 1940. Between teaching assignments, he had been chief engineer with The Moran Co., shipbuilders; and had served with the U. S. Shipping Board Emergency Fleet Corp.; and with the Pusey and Jones Co. He had also done much consulting work involving design, research, powerplant testing, and such. He was a member also of SPEE, AIEE, AMA. He was a registered professional engineer in the State of New York. Member also of Tau Beta Pi and Sigma Xi. Survived by his widow; a daughter, Mrs. Alfred Larke; and a son, Lieut. Col. L. S. Ayars of the Air Force Medical Corps; and five grandchildren.

John Howard Chaplin (1893–1958), president and chairman of the board, Veeder-Root, Inc., Hartford, Conn., died Aug. 15, 1958. Born, Georgetown, Washington, D. C., Dec. 4, 1893. Parents, Wilfred S. and Helen (McAllaster) Chaplin. Education, PhB, Yale University, 1915. Married Shirley Ingraham. Mr. Chaplin had been with Veeder-Root, Inc., since 1917; was made vice-president in 1932; and became president and director in 1931. He was a director also of the Holo Krome Screw Corp., Connecticut Bank & Trust Co., and several other firms.

Paul Jay DeKoning (1914–1958), associate professor of applied mechanics, Michigan State University, East Lansing, Mich., died June 20, 1958. Born, Grand Rapids, Mich., Feb. 3, 1914. Parents, Jacob and Sophia DeKoning. Education, BS, Michigan State College, 1935; ME, 1948; MS, 1950; graduated, Moody Bible Institute, 1940. Married Doris M. Strong, 1941; children, David Brian, Kristina Ruth, and Gwenda Sue. Mem. ASME, 1952. A member of the faculty at MSU since 1940. Mr. DeKoning held patents for test-plate soiling apparatus and a photoelectric soil analyzer. Member also of ASTM and ASA. Survived by his widow and three children; his parents; and one sister, Mrs Merton Klinker.

John James Greagan (1884–1958), retired district manager, Allis-Chalmers Manufacturing Co., Birmingham, Ala., died Aug. 19, 1958. Born, Albany, N. Y., May 31, 1884. Education, high-school graduate. Assoc-Mem. ASME, 1917; Mem. ASME, 1921. Mr. Greagan helped to organize the Birmingham Section of ASME. He acted as secretary and treasurer of the Section, 1919–1920; and served as a member of the local Executive Committee, 1919–1921. During World War II, he served the War Production Board. Survived by his widow; a son, John J., Jr., Charlotte, N. C.; and two daughters, Mrs. John Forster, Jr., and Mrs. Ralph McClung; and six grandchildren.

Frank Alricks Haughton (1870–1958), retired consulting mechanical engineer, General Electric Co., Schenectady, N. Y., died July 29, 1958. Born, Cheshire, England, May 23, 1870. Parents, Henry Osburne and Sophia Ridgly (Alricks) Haughton. Education, Institute School of Design, Baltimore, Md. Naturalized U. S. citizen, Herkimer, N. Y., 1915. Married Louise de B. Steuart, 1896; children, Henry O., Louise S., and Frances M. Mem. ASME, 1903. Prior to his retirement in 1941. Mr. Haughton had been with GE for 20 yr. Previously he had been with Remington Arms and Ammunition Co., and with Taylor Iron and Steel Co. He held numerous patents pertaining to locomotive superheaters, steam generators, and such.

Carl Albert Herrick (1879–1958?), retired professor of mathematics and mechanics, University of Minnesota, Minneapolis, Minn., died recently according to a report received by the Society. Born, Minneapolis, Minn., Aug. 18, 1879. Parents, Albert E. and Abbie J. (Weatherbee) Herrick. Education, ME, University of Minnesota, 1902. Married Georgia M. Swett, 1904; children, Robert C. (deceased), Chester E., Margaret C., and Richard G. Mem. ASME, 1912. Mr. Herrick had been on the faculty of the University of Minnesota since 1918. He had been a fellow of AAAS and a member of SPEE. Member also of Sigma Xi.

Richard Singleton Hopkins (1896–1958), superintendent, Kearny Generating Station, Public Service Electric and Gas Co., Kearny, N. J., died July 18, 1958. Born, West Orange, N. J., Aug. 13, 1896. Parents, Robert and Ida Wheeler Hopkins. Education, ME, Stevens Institute of Technology, 1919. Mem. ASME, 1949. Mr. Hopkins had been with Public Service since 1919. Survived by his widow, Leonora Hopkins.

James Farr McGaffin (1933–1958), instructor, Rensselaer Polytechnic Institute, Troy, N. Y., died Aug. 15, 1958. Born, Ningpo, China, Sept. 22, 1933. Education, BEE, Rensselaer Polytechnic Institute, 1955; MME, 1956. Assoc. Mem. ASME, 1956.

James M. Meany (1884–1958?), whose death recently was reported to the Society had been manager, Logging Department, Loggers and Contractors Machinery Co., Portland, Ore. Born, Lake City, Minn., April 6, 1884. Education, BS(ME), University of Minnesota, 1907. Assoc-Mem. ASME, 1917; Mem. ASME, 1921. Mr. Meany was a specialist in the design and sale of logging machinery. Member also Sigma Xi. Survived by his widow.

Otto Muller (1884–1958), consulting engineer, formerly in charge of development of new production equipment, American Optical Co., Southbridge, Mass., died Aug. 20, 1958. Born, New York, N. Y., March 2, 1884. Parents, Otto Hans and Louise Rosa (Hoseman) Muller. Education, attended Cooper Union; ICS. Married Elsie Louise Kneher, 1908. Mem. ASME, 1933. Mr. Muller was a registered professional engineer in New York and Massachusetts. During his career he had taken out many patents on his own inventions, as well as a long list of patents assigned to his employers. He had served the Worcester Section of ASME as a member of the Executive Committee, 1935–1939. Survived by his widow; one son, Richard J. Muller; a grandson, Barton R. Muller; and a sister, Mrs. Otto Krack.

Carl August Otto (1896–1958), vice-president and chief engineer, Johnson Service Co., Milwaukee, Wis., died Sept. 2, 1958. Born, Oshkosh, Wis., June 17, 1896. Mem. ASME, 1938. Mr. Otto had been with Johnson Service Co. since 1922. He held numerous patents relating to the development, production, and application of pneumatic controls to process variables and air-conditioning installations.

Paul Miller Rotzler (1923–1958), mechanical engineer, Elliott Co., Jeannette, Pa., died July 7, 1958. Born, New Brighton, Pa., Jan. 21, 1923. Parents, Dr. and Mrs. William F. Rotzler. Education, BS(ME), Carnegie Institute of Technology, 1947. Married Martha Morrill. Assoc. Mem. ASME, 1947. During World War II, he served as an officer in the U. S. Air Force. Member of Pi Tau Sigma. Survived by his widow; one son, Reid; his parents, a brother, and two sisters.

Raymond Anton Schakel (1900–1958), manager, engine-drive dept., Diamond Chain Co., Indianapolis, Ind., died Aug. 30, 1958. Born, Indianapolis, Ind., June 4, 1900. Parents, Anton H. and Mary L. Schakel. Education, BS(ME), Purdue University, 1922. Married Lila Rose. Mem. ASME, 1949. Mr. Schakel joined the Diamond Chain Co. in 1924.

James Uriel Smith (1871–1958?), whose death recently was reported to the Society, was retired and had formerly been with Pacific Gas and Electric Co., Berkeley, Calif. Born, Smith, Nev., Sept. 6, 1871. Education, BS(ME), University of California, 1894; MS, 1899. Mem. ASME, 1928. Prior to his retirement he had been with Pacific Gas and Electric since 1916.

Howard Grant Thompson (1896–1958?), chairman, Soft Water Supply, Ltd., London, Ont., Canada, died recently according to a report received by the Society. Born, London, Ontario, Canada, Aug. 21, 1896. Education, BS(ME), University of Toronto, 1922. Mem. ASME, 1940. Colonel Thompson had been assistant general secretary of the Engineering Institute of Canada. During World War II he was in active service with the Canadian Army. He was selected, in 1937, to organize and command the first Canadian Reserve Army Field Workshop. This unit was mobilized in 1939 and with the rank of lieutenant colonel he served overseas. In 1941 he was appointed Chief Ordnance-Mechanical Engineer at Defense Headquarters in Ottawa with the rank of colonel. As technical observer for the Canadian Army, he went, in 1942, to the Middle East. Colonel Thompson supervised the formation of the Royal Canadian Electrical-Mechanical-Engineers Corps in the Canadian Army overseas and in 1944 became Director of Mechanical Engineering at Army Headquarters in Ottawa. He was honored in 1945 with the Medal of the Engineering Alumni of the University of Toronto for outstanding achievement in the field of engineering. He was a member also of I. Mech. E. and the Canadian Institute of Mining and Metallurgy.

Frank Gardner Walter (1916–1958), superintendent, Mechanical Division, Mandan Refinery, Standard Oil Co. (Ind.), Mandan, N. Dak., died May 31, 1958. Born, Chicago, Ill., Nov. 30, 1916. Education, BS(ME), University of Illinois, 1939. Mem. ASME, 1948. Mr. Walter was a registered professional engineer in the State of Illinois. He had been with Standard Oil since 1942.

Walter Farrington Wells (1870–1958), retired vice-president and general manager of the Brooklyn Edison Co., died Aug. 30, 1958. Born, Rahway, N. J., Jan. 10, 1870. Education, attended Rutgers College special engineering course, 1892. Mem. ASME, 1914. Mr. Wells had directed the installation of the electrical plant at the water-side generating station at 38th St. and the East River in New York City. He was placed in charge of its operation in 1901. The plant is now a unit of Consolidated Edison. In 1913 Mr. Wells was elected vice-president and general manager, and a director of Edison Electric of Brooklyn and the Kings County Electric Light and Power Co. In 1919 the companies merged to form the Brooklyn Edison Co. Mr. Wells was a past-president of the Association of Edison Illuminating Companies and the National Electric Light Association. Survived by a daughter, Mrs. Kenneth M. Bevier, Scarsdale, N. Y.; and three grandchildren.

Ford Lee Wilkinson, Jr. (1895–1958), president, Rose Polytechnic Institute, Terre Haute, Ind., died Sept. 1, 1958. Born, Elkton, Ky., Aug. 15, 1895. Parents, Ford L. and Sue (Russell) Wilkinson. Education, BS, U. S. Naval Aacdemy, 1918; postgraduate study at USNA, 1924; MS, Columbia University, 1925; hon. DE, University of Louisville, 1947. Married Lois Smyer, 1927. Assoc-Mem. ASME, 1926; Mem. ASME, 1929; Fellow ASME, 1956. In the years following his graduation from the Naval Academy, Dr. Wilkinson served in the Navy in a number of capacities from convoy officer to commanding officer of the U. S. Submarine S-18. He resigned, in 1927, with the rank of Lieutenant, USN. Before entering the academic world Dr. Wilkinson had been associated with Wilson-Weesner-Wilkinson Co., Nashville, Tenn.; the Bureau of Smoke Regulation, Knoxville, Tenn.; and the Riley Stoker Co. He joined the faculty of the University of Tennessee as assistant professor, in 1933, and successively was associate professor, professor, and head of the department of mechanical engineering. During this period he conducted preliminary steam studies for the TVA system. As dean of Speed Scientific School, 1938–1947, Dr. Wilkinson established and organized the Louisville Institute of Industrial Research and served as its president. In 1947 he was appointed the first academic dean of the U. S. Naval Postgraduate School, a post which he retained until 1949. He assumed the presidency of Rose Polytechnic Institute in 1949. Under his administration, major modifications and additions to the school's facilities had been made. In 1951 Dr. Wilkinson was a member of the American Advisory Mission to Japan for engineering education. He served the Society on a local and national level. At the time of his death he was a member of the Board on Public Affairs. In 1945–1947, he had been a vice-president of ASME. He was a member also of ASEE, AAAS, and other societies. Tau Beta Pi, Sigma Tau, Phi Kappa Phi, and the Newcomen Society also included him among their members. He was a registered professional engineer in the State of Indiana. Survived by his widow; a daughter, Walta; and four brothers and a sister.

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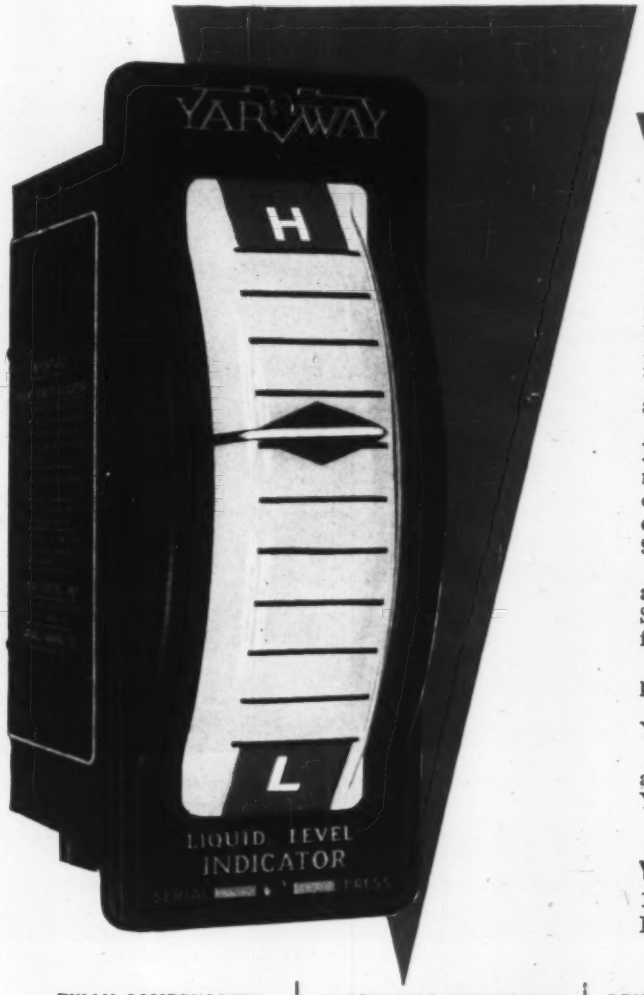

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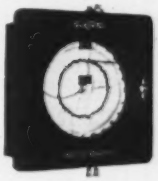

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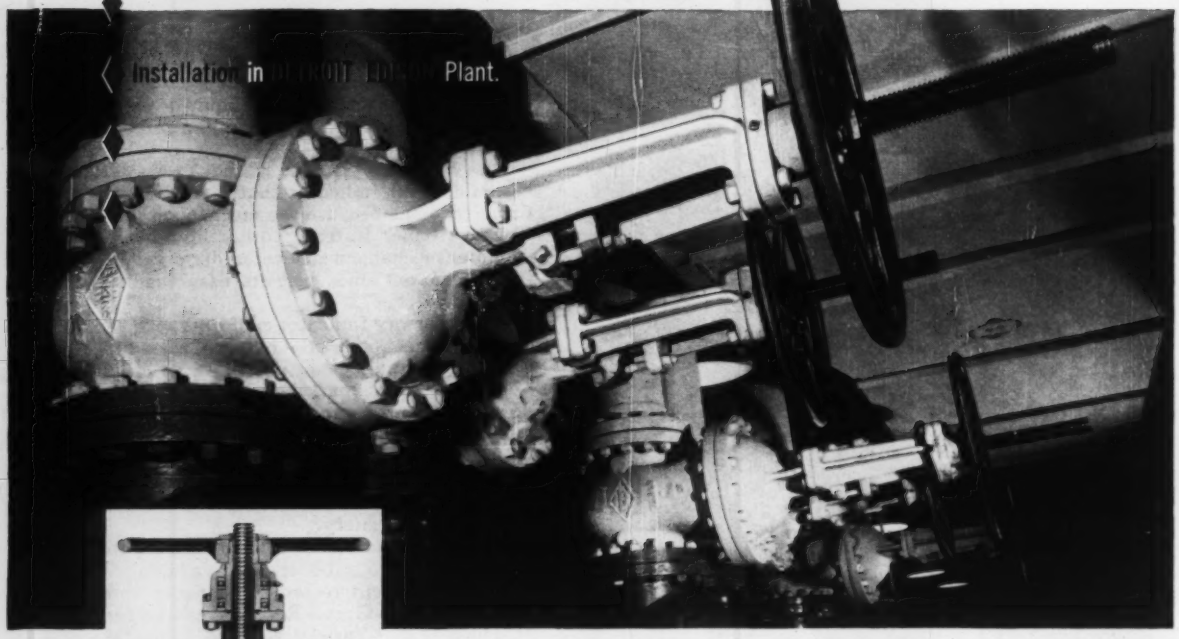
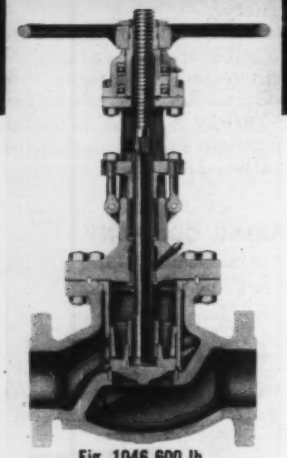


Installation in [illegible] Plant.



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NEW EQUIPMENT

Explosion-Proof Control

A new Mercoid pressure control for use in hazardous locations has been announced.

It is listed by Underwriters Laboratories, Class 1, Group C and D, Class 2, Group E, F and G, (Nema 7-9, 9A). The new control has been designed to be used where space and weight are an important factor in control installations.

The unit features external adjustments for setting operating range, visible calibrated dial, visible hermetically sealed mercury switch; 1/2 in. external pressure connection with 1/4 in. internal pressure connection.

Finish is natural aluminum. Dimensions are width 7 3/4 in., height overall including pressure connection 9 7/8 in. and dept of 5 in.

It is available in 21 operating ranges from 0-30 in. vacuum to 0-1000 psi. —K-1

Mechanical Seals

Borg-Warner Corp. has formed a new division to manufacture, sell, and service mechanical seals.

The mechanical seal is a shaft sealing device, used to replace the packing in a conventional centrifugal pump stuffing-box, or the gland of a rotating shaft. Using precision-lapped faces, it is designed to withstand extreme conditions of temperature and pressure without leakage. It is also said to eliminate down-time for repacking, as needed with a conventional stuffing box. —K-2

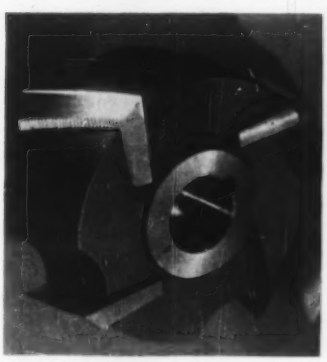
High Capacity Feeders

Special model heavy-duty electromagnetic vibratory feeders, designed for high capacity feeding where installation space is limited, are announced by Syntron Co.

The feeders combine two standard electromagnet drive units to provide the power necessary to convey heavy materials at fast feeding rates through extra long trough, the company reports.

Separate electromagnet drives, which operate in alternate co-ordination, are mounted above and below the trough to eliminate the extra length required for standard electromagnet drive mounting. The firm's range of models offers maximum feeding capacities ranging from 25 to more than 1000 tons per hour in dry materials weighing approximately 100 lb per cu ft.

The company states that feeders can be built with standard or special troughs or stainless or regular steels. They can also be equipped with dust-tight covers for magnets and troughs and with dust seal attachments for trough inlets and discharges for materials which necessitate dust control. —K-3



Magnesium, Aluminum Milling

New micro-finish milling cutters for aluminum and magnesium have been announced by O. K. Tool Co.

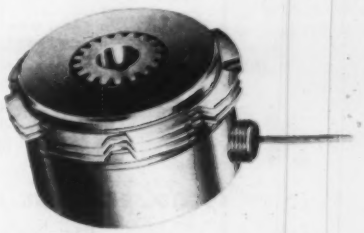
The company states that the cutter was developed for the milling of aluminum and magnesium to tenths, holding a 30 micro-inch finish or better and should eliminate many grinding and hand-finishing operations on aircraft and missile parts.

The unit, called Microcut, has highly finished cutting edges and polished flutes. It is available in inserted, wedge-type and solid type cutters, including high-speed steel, cast alloys, and carbide. —K-4

Pressure Vessel Flange

An economical pressure vessel connection design, combining a flange and a seamless weld-end extension, has been announced by the Lenape Hydraulic Pressing and Forging Co.

Use of a special ASA manway flange mated with a weld-end extension is said to offer significant savings over conventional long welding necks in ID sizes from 16 to 24 in., and in lengths over 12 in. The extension can first be welded to the vessel, then the flange welded to the extension without refacing the flange, the firm reports. The joining weld can be X-rayed. —K-5



Electric Clutches, Brakes

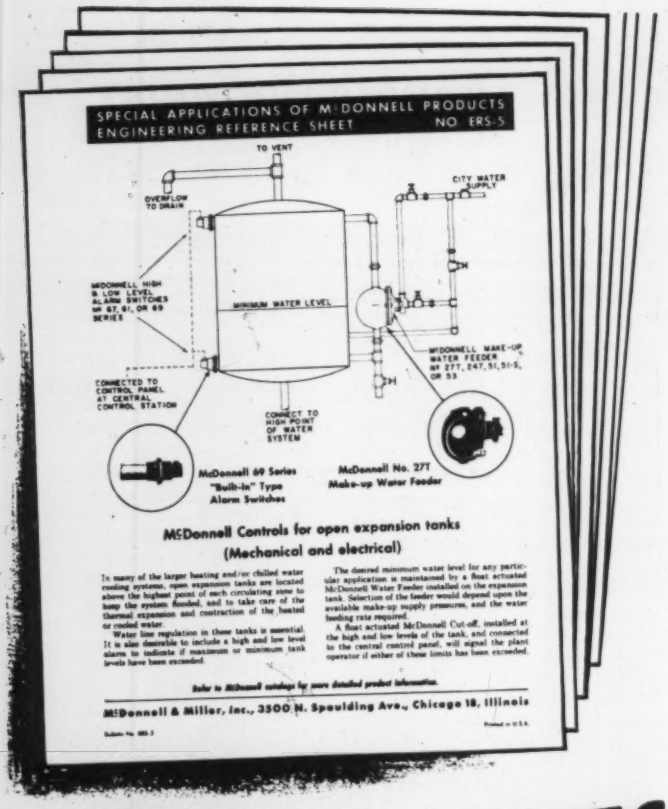
Carlyle Johnson Machine Co., announces its 9000 series, flux-through disk type of electric clutch with stationery coil.

The manufacturer points out that the clutches and brakes do not, in any sense, replace or supersede its 8000 series Maxitorq electric clutches. This new line covers a range of sizes from 3/4 to 3 1/2 in. bore and up to 2400 lb ft of torque (static).

The units incorporate the firm's design principles of floating disk units. The company says they combine a specially developed disk assembly design with a new type of electro-magnetic operating mechanism, by means of which the clutch, or brake, is held in engaged position by the action of magnetic flux passing through buttress plate, disk assembly and end plate.

Upon release, disk separators not only separate the disks individually, but also break up residual magnetism to assure a positive "floating" neutral which will not creep, drag, or heat, the firm reports.

Since the clutch is actuated entirely by the magnetic flux, there are no levers or other highly stressed parts. There are no frictional contacts between moving and stationary units other than the coil housing bearings. In case of current failure or safety device cut-out, the clutch disengages. —K-6


SPECIAL APPLICATIONS OF McDONNELL PRODUCTS
ENGINEERING REFERENCE SHEET NO. ERS-5

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CITY WATER SUPPLY
McDONNELL HIGH & LOW LEVEL ALARM SWITCHES as 67, 51, OR 69 SERIES
MINIMUM WATER LEVEL
McDONNELL MAKE-UP WATER FEEDER as 277, 247, 51, 51-S, OR 53
CONNECTED TO CONTROL PANEL AT CENTRAL CONTROL STATION
CONNECT TO HIGH POINT OF WATER SYSTEM
McDonnell 69 Series "Built-In" Type Alarm Switches
McDonnell No. 277 Make-up Water Feeder

McDonnell Controls for open expansion tanks
(Mechanical and electrical)

In many of the larger heating and/or chilled water cooling systems, open expansion tanks are located above the highest point of each circulating zone to keep the system flooded, and to take care of the thermal expansion and contraction of the heated or cooled water.

Water line regulation in these tanks is essential. It is also desirable to include a high and low level alarm to indicate if maximum or minimum tank levels have been exceeded.

The desired minimum water level for any particular application is maintained by a float actuated McDonnell Water Feeder installed on the expansion tank. Selection of the feeder would depend upon the available make-up supply pressures, and the water feeding rate required.

A float actuated McDonnell Cut-off, installed at the high and low levels of the tank, and connected to the central control panel, will signal the plant operator if either of these limits has been exceeded.

Refer to McDonnell catalogs for more detailed product information.

McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18, Illinois

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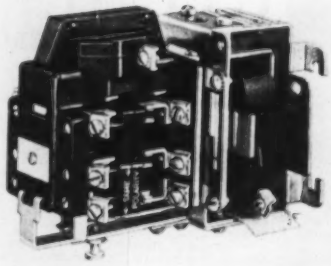

New Mechanically Held Control Relay

A new line of mechanically held control relays, rated at 10 amp, 600 v, has been announced by Square D Co.

The Type D relays mount in the same panel space as standard electrically held relays. The firm says this feature eliminates the need for mounting mechanically held relays separately. With this new design, both mechanically and electrically held relays can now be mounted on the control panel in the proper sequence as they appear on the elementary diagram, the company reports.

The relays are offered as completely factory-assembled units, or as electrically held relays and mechanically held attachments for customer assembly. They are available in a variety of units up to ten contacts. —K-7

Pilot-Thermocouple

A new higher input pilot-thermocouple combination has been developed by Grayson Controls Div., Robertshaw-Fulton Controls Co. for use in water heaters, gas central heating equipment, and other commercial appliances.

The pilot, rated at 400 Btu an hour input, has a non-aerated design to eliminate the possibility of clogging with lint. —K-8

Vinyl Wrinkle Finish

A vinyl wrinkle finish for metals can be prepared by incorporating a compound known as monomer MG-1 into vinyl plastisol, organosol, or solution coating formulations, it is announced by Union Carbide Chemicals Co., and Union Carbide Plastics Co., Divisions of Union Carbide Corp.

The mixtures can be sprayed and then baked to give a finish that is tough, scratch-resistant and esthetically pleasing, the firm states. It is believed that a difference between the rate of polymerization of Monomer MG-1 (polyethylene glycol dimethacrylate) and the rate of vinyl resin fusion causes uniform wrinkling to occur in this type of finish.

The new finish developed is said to be unique in that it marks the first time that a means of producing a vinyl wrinkle finish has been available. —K-9

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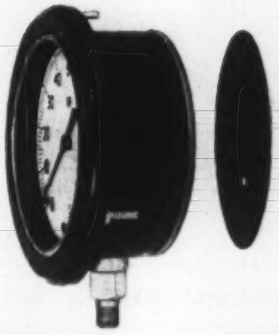

Pressure Gage

A newly designed pressure gage with a solid and integrally cast metal front plate has been announced by Helicoid Gage Div., American Chain & Cable Co.

The firm says departure from normal construction consists mainly of a solid metal front plate which forms a partition or protecting wall between the dial and the tube. This partition is designed to divert the force of a burst in a backward direction, away from the operator, where it is permitted to escape by deforming the back cover plate.

Designated as the Safe-T-Case gage, its gasketed and deformable back plate covers the entire rear of the unit and can be forced open by a minimum pressure of 3 psi. For added safety in the event of a sudden high pressure surge, this back plate which is held in place by a threaded screw, will not detach itself from the gage, the company states. The readily removed plate provides quick and convenient access to the Bourdon tube and movement assembly for inspection, recalibration, or repair without the necessity of removing the indicator dial. —K-10

Miniature Motor

Western Gear Corp., Electro Products Div. announces design and manufacture of a new 200 v, 400 cycle, miniature 3 phase a-c motor, Model 35YH37.

The motor develops $1/20$ hp at 6500 rpm. It was originally designed as a fan motor to circulate air in an aircraft deep freeze compartment. It draws .42 amp and measures $2\frac{1}{2}$ in. in diam and $2\frac{1}{2}$ in. in length. —K-11

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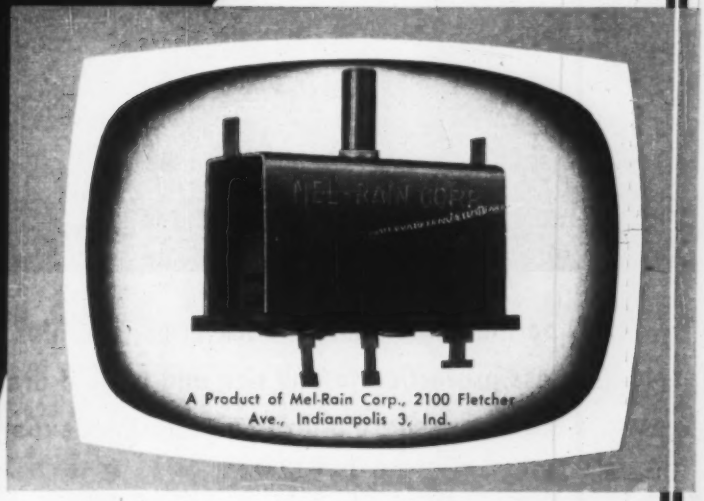
THE MEL-RAIN TV CIRCUIT PROTECTOR



A Product of Mel-Rain Corp., 2100 Fletcher Ave., Indianapolis 3, Ind.

While all will agree that TV circuits need protection against malfunctioning, especially for conditions which could start fires, the nuisance and high cost of fuse replacement by a service man is abominated by all. Mel-Rain Corporation has licked this problem with their line of TV Circuit Protectors. They make the set inoperative in case a hazardous condition exists but, since a high percentage of failures is due to ageing or intermittent surges, the set may be put into use immediately by simply resetting the button. The Mel-Rain design also prevents "cycling" and sticking of contacts, and the breaking of the circuit by high ambient temperatures both in the set and in the room. The units are low-cost, reliable and handle a current range from 100 MA to 7½ amperes in a temperature spread up to 150°.

Here is a case where *reliability* in the protective device must be obtained at low cost, as competition is severe among TV manufacturers. Known for a third of a century for its dependability and precision, Chace Thermostatic Bimetal is also far and away the best *buy* in bimetal. The quality which results from Chace's processes reduces rejects to an almost incalculable fraction of a percentage point, an indication of the skill of our manufacturing and the thoroughness of our development, testing, and inspection methods. Final proof, of course, is the satisfaction which products actuated by Chace bimetal give to their owners, year after year.

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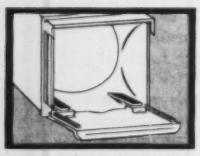

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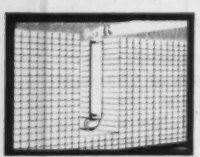

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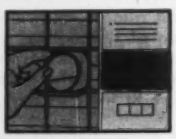

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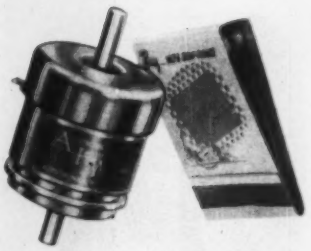

Electro-Magnetic Brake

Autotronics Inc. has announced an industrial miniature-B-125 electro-magnetic brake. The new brake features, high torque (40 oz-in. min.) per unit size, is completely self-contained and light weight (6 oz-in.). It has 1.125 servo mounting diameter, or face mounted.

The unit is said to feature quick response, 0 deg backlash. No slip rings are required. The brake is available with output shaft out either or both ends. **—K-12**

Metal Connectors

A line of general purpose flexible metal connectors developed by Korfund Co. features a new, unique braid design providing especially high burst strengths.

Designated Flex-Hose, the flexible metal hose sections attenuate transmission of vibration and pulsations into the rigid piping, the firm states, adding that they isolate pipe lines from pumps, compressors, air conditioners, radiators, air handling units, fuel lines, which create objectionable vibration. They also compensate for misalignment and reduce strain on piping.

It is constructed of corrugated, high-quality seamless tubing, protected and reinforced by outer braiding. Both the tubing and braid are made from either bronze or steel, depending upon hose size and operating conditions.

Maximum steady working pressures at 70 F vary with size up to 1700 psi. Operating temperatures can be as high as 750 F, depending upon materials used. Pressure ratings can be increased by as much as 75 per cent by use of multiple braiding, the company reports. **—K-13**

Aluminum Plate

Thick aluminum plate is available for the first time in high strength alloy 7079 for light metal applications in the jet aircraft industry, Aluminum Co. of America announces.

The properties of alloy 7079, used by the aircraft industry for extrusions and forgings, now can be obtained in 7079-T651 plate. Ranging in thickness from 3 to 6 in., the new product is guaranteed to be within the ultrasonic testing acceptance limits for class A areas determined by the Society for Non-Destructive Testing, the company states. **—K-14**

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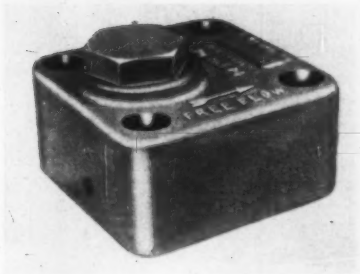

Check Valves

A new series of check valves for operation in hydraulic systems up to 5000 psi is announced by Denison Engineering Div., American Brake Shoe Co.

The new valves come in both the subplate-mounted and sandwich types. Both subplate and sandwich types of the valves are available in either $^3/_4$ or $1^1/_4$ in. sizes. Subplate type valves meet JIC standards and are available with or without matching subplate.

The $^3/_4$ in. subplate valve is available with either $^3/_4$ in. pipe tap connection or UNF connection. The $1^1/_4$ in. subplate valve is available only with $1^1/_4$ in. pipe.

The sandwich type check valve can be added to a hydraulic circuit without adding or breaking pipe connections, the firm states. The valve is designed to fit between any of the company's subplate-mounted sequence valve (in $^3/_4$ and $1^1/_4$ in. sizes) and the subplate itself. —K-15

Titanium Solder, Flux

A new and more economical filler metal, Curtisol, and Curtiflux, a fluxing agent, for low temperature titanium torch soldering have been developed by Research Div., Curtiss-Wright Corp.

The filler metal is a special solder developed for titanium and titanium base alloys. It has a flow temperature between 1300 and 1400 F depending on the exact composition.

The firm reports that joints with tensile strengths of greater than 40,000 psi can be made by anyone familiar with torch soldering techniques. The solder also can be used for short time vacuum furnace or inert atmosphere brazing without flux.

The fluxing agent is specifically compounded for low temperature silver solders. It melts at about 1000 F and can be heated to 1500 F without decomposing, sputtering, or balling up. It remains translucent at the working temperature of the silver solder, allowing observation of the bonding process. The wetting action of the flux results in an improved "feathering out" of the solder on the titanium surface, the company states. The flux is easily removed with a water-acid dip. —K-16

ROCKFORD

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Compared to previous type clutch facings, Morlife® Clutch facings reduce foot pedal pressure up to 50%. They assure positive engagement—with power-holding grip. Provide a degree of heat resistance and dissipation never before available. They give several times the durability for prolonging clutch life and extend the time between pedal adjustments many times as long. Let ROCKFORD clutch engineers show you how these new advantages will improve the operating ease and prolong the on-the-job life of *your* product.

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Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

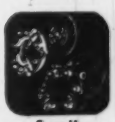
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Table-Room Cleaner

A 6-ft Rotoblast table-room for cleaning work in jobbing foundries and plants that require a flexible machine for a wide range of cleaning operations, has been introduced by the Pangborn Corp.

It is said to be capable of blasting castings, forgings, and stampings up to 72 in. diam by 36 in. high, and weighing up to 5000 lb. The table is equipped with a cast labyrinth abrasive sealing system which makes the cabinet abrasive tight without rubber gaskets. The cabinet doors open to expose approximately 4 in. more clearance back of the cabinet centerline.

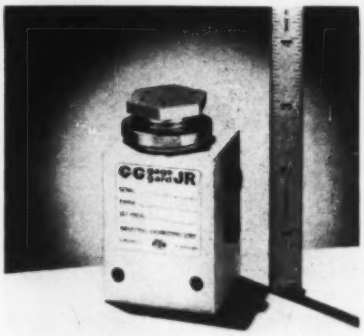
A single overhead wheel, powered by a 30 hp motor, will throw 50,000 lb of abrasive per hour, the firm reports. Power operated guard plates that are positioned in front of the wheel when the motor is turned off prevent abrasive from striking the table. When abrasive wheel is turned on again, guard plates retract to original position. **—K-17**

Teflon Adhesives

Two adhesives for cementing bondable Teflon to itself or to other materials have been announced by the Adhesives Dept., Raybestos-Manhattan, Inc.

The first, Ray-BOND R-86009, is recommended by the company for applications where some flexibility in the bond is required. It has good resistance to water and most chemicals. The other, Ray-BOND R-86044, is said to feature excellent resistance to acids, except acetic, and various other chemicals, as well as water.

Both materials are two-component (base and activator) systems which will bond etched Teflon to wood, steel, glass, aluminum, ceramics, plastics, or any other material that will bond with an adhesive, the firm reports. They may be cured at room temperature or at elevated temperatures. **—K-18**



Instruments Protector

A new device offering positive protection for incline manometers, draft gages, electrical pressure switches, and ultra-sensitive low pressure transducers has been announced by Industrial Engineering Corp.

Designed for either atmospheric or relative pressure system applications, the new product has been named Gage Gard Jr.

The unit is repeatable and will reopen after sealing at 2 per cent below the cut-off point. Adjustment and resetting of cut-off pressure point can be made at any time, the firm reports. Available in four ranges, from −15 psig to +85 psig. **—K-19**

Vibrating Conveyors

Designs and dimensions for three new high temperature vibrating conveyors manufactured by Carrier Conveyor Corp., have been detailed in the company's new Model HT catalog.

The catalog explains in detail how the drive mechanism and specially engineered conveying troughs meet the requirements of various high temperature material handling applications. The conveyors can handle hot materials up to1 800 F. **—K-20**

Definitions of Occupational Specialties in Engineering

This book contains comprehensive data related to all activities and specializations in engineering including specific knowledge and duties, responsibilities and related techniques necessary for successful performance in each field.

The ten activity fields defined are research, design, development, testing, procurement, production, construction, operation, administration, and teaching.

Major engineering fields of specialization defined include aeronautical, automotive, ceramic, chemical, civil, electric and electronics, guided missiles, management, marine, materials, mechanical, metallurgical, mining, naval, nuclear reactor, ordnance and armament, petroleum and fuels and power plant engineering. Other engineering fields defined are: packaging, photogrammetry, agriculture, geology, and geophysics.

Pub. 1952 Price: $2.50, 20% less to ASME members.

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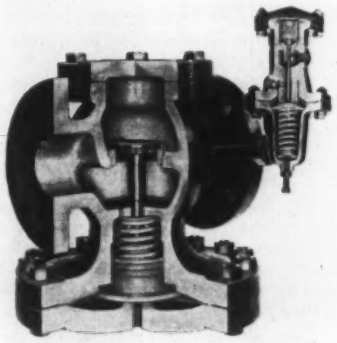


Pressure Regulators

Kieley & Mueller, Inc. has announced a new line of external-pilot steam pressure regulators said to have greater capacity per valve size, provide accurate, fast-response regulation and are suitable for continuous or intermittent duty.

The new regulator incorporates an integral bleed orifice which eliminates one inter-connecting pipe line usually required on pilot-operated regulators of this type.

Called the Type 471, the regulator is capable of large pressure reductions and the tight, dead-end shut-off necessary for batch-type apparatus such as sterilizers, vats, kilns, presses, and ovens. Positive shut-off is accomplished by a single-seat valve arrangement which employs stainless steel valve disks and seat rings.

The regulator consists of a main valve that will handle maximum pressures of 125 or 250 lb, and an external pilot valve. If the main valve must be inconveniently located, the pilot can be remotely installed in an accessible location, the company states.

Regulation is achieved through the use of a low-rate spring in the pilot, the absence of stuffing boxes in either pilot or main valve, and the relatively frictionless operation of the large diaphragms in both units. To protect the control spring from the erosive effects of high-pressure steam, the spring is isolated in a chamber which is out of the main steam flow.

—K-21

Check Valve

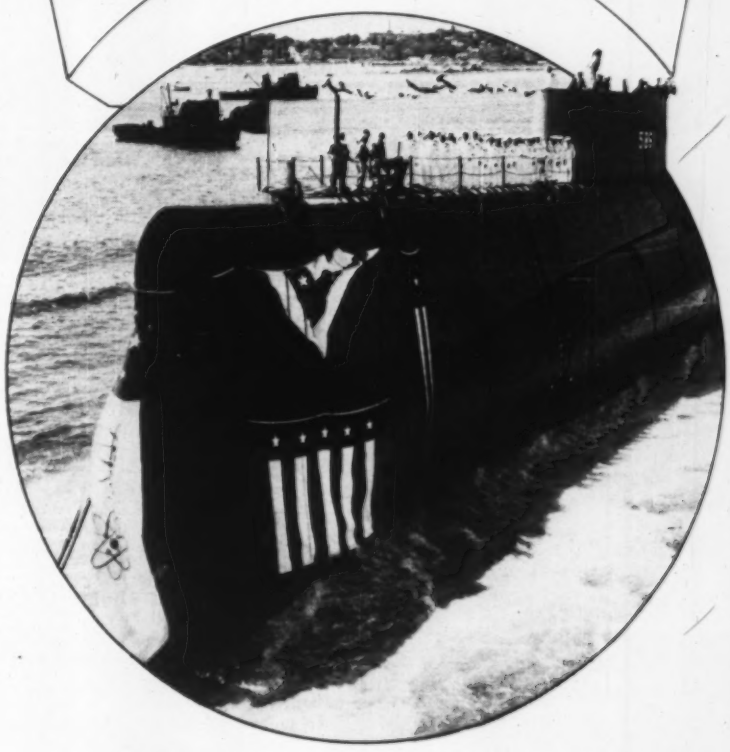
A new check valve for liquids, vapors, and gases that functions with optimum efficiency at any pressure from 0 to 3000 psi has been announced by Sealol Corp.

Valves with a range of 3000 to 6000 psi are now being tested and will be available shortly, the company reports. The unit is designed so that low pressures seat the poppet on a resilient disk inset in the body. As pressures increae, the rubber disk is radially displaced and a metal-to-metal seat results.

The new valves are available in $\frac{1}{4}$ through 4 in. in pipe sizes and $\frac{1}{4}$ through $1\frac{1}{2}$ in. in tubing sizes.

—K-22

BONNEY WELDOLETS
for the world's biggest
ATOMIC SUBMARINE



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Bonney Weldolets featuring strength, improved flow conditions and easy, economical installation are used on the atomic-powered TRITON, world's largest and most powerful submarine. Launched in August, 1958 at the Groton, Connecticut shipyard of General Dynamic's Electric Boat Division, this twin-reactored sub—447 ft. long and displacing 5,900 tons—is scheduled for radar picket duty.

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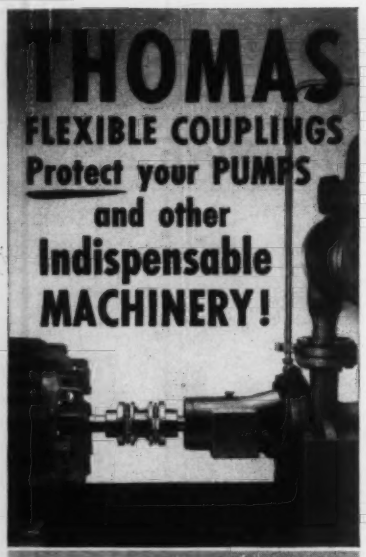
ALLENTOWN, PENNSYLVANIA



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NO MAINTENANCE
NO WEARING PARTS

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Aluminum Housing

Development of an aluminum distribution transformer housing easily manufactured from extrusions is announced today by Reynolds Metals Co.

The extruded sectors, which have ready-made fins for dissipating heat, are applicable to the 25 KVA and larger transformer sizes, according to the company. They incorporate lifting lugs, hanger attachments, and core and coil supports. The aluminum tank, according to the firm, weighs less than one-third of its steel equivalent. **—K-23**

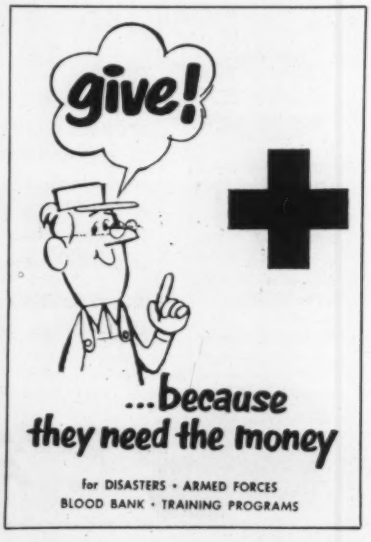
Electronic Gear Cutter

New Equipment Div., S & S Machinery Co., announces the introduction from Switzerland of the Frimatic super-precision electronic gear cutter and hobber, reputed to be the fastest and most precise machine of its kind in the world.

It is designed for automatic high-speed production of small gears and pinions for standard and special tooth forms such as are used in meters, watches, cameras, and precision instruments.

The unit handles work up to $1^3/_8$ in. diam by 1 in. length in any machinable material completely automatically. On special request the capacity can be increased up to 2 in. in diam and 4 in. in length (hand loading), the firm reports. It features constant automatic loading, automatic indexing and locking, rapid reversal of table and electronic preselection of cutter speeds up to 10,000 rpm in both directions.

Its production speed is said to be capable of automatically producing 0.47 in. diam, 0.27 in. length gears with 15 teeth in brass at the rate of 500 per hour with fine finish; 0.19 in. diam, 0.27 in. length pinions with 7 teeth can be produced in steel with fine finish at the rate of more than 210 per hour. **—K-24**



Horizontal Pumps

A line of horizontal split case pumps for hot and cold water handling, designated as Aqua-Line, has been introduced by Peerless Pump Div., Food Machinery and Chemical Corp.

Designed for the general purpose applications of the building trades, the pumps are available in shaft sealed types in $1^1/_2$ to 4 in., discharge sizes and in packing gland types in 4 to 8 in. discharge sizes. Capacity and head ranges of the packing gland types are up to 2600 gpm and up to 280 ft, respectively, and capacity and head ranges of the shaft sealed types are up to 950 gpm and up to 350 ft, respectively.

Liquid temperature limits for the shaft sealed types is 180 F and for the packing gland types is 250 F. Motor sizes range from 1 to 75 hp. **—K-25**

Writing Recording Systems

Six or eight interchangeable preamplifiers mounted in a single module in 7 in. of panel space and a recorder-power amplifier-power supply package permit extreme compactness in new 850 series direct writing oscillographic recording systems announced by Sanborn Co.

The units are designed for applications of medium size d-c signals such as telemetry, analog computer readout. A complete 850 system is housed in a single cabinet 60 in. high.

The preamplifiers measure approximately $2 \times 7 \times 14^1/_2$ in. Presently available are Model 850-1200 phase sensitive demodulator for use with resolvers, synchros, differential transformers, and Model 850-1300A d-c coupling for various single-ended or balanced input signals. **—K-26**

Hinged-Pan Conveyor

A conveyor for the handling of scrap that eliminates clogging, wedging, and spilling is announced by Gifford-Wood Co.

Called hinged-pan, the conveyor is designed with multiple closely-fitted pan joints which leave no opening during movement for sharp-edged scrap to become wedged in. The firm says special side flanges prevent scrap from spilling over in transit by forming a continuous deep moving pan.

All mechanical wear during normal operation is restricted to two replaceable parts. These are a roller and bushing on each hinge pan. They encounter friction as they follow a chain track, and if worn excessively are replaced by means of a press-fit cotter pin, the firm states.

Each hinged-pan conveyor is a self-contained unit consisting of a head and tail shaft assembly mounted on structural steel framework and usually installed in a trench beneath floor level. Motor drive assembly is located at the head shaft, while return chain wheels and take-up terminals for adjustment are located at the tail shaft. **—K-27**

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BUSINESS NOTES
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Bolted Bonnet Valve

Jerguson Gage & Valve Co, announces a new, improved type of outside screw & yoke bolted bonnet valve, for use with liquid level gages and instruments.

The new bolted bonnet uses a forged yoke which supports the stem away from the valve body and a separate forged gland-follower which bears directly on the packing and is entirely independent of the yoke.

The firm explains that this construction places the threaded portion of the stem outside of the valve body where it is not affected by temperature or nature of the liquid being handled. The design allows the valve stem to work freely at all times and prevents possible freezing.

Valves constructed with the new bolted bonnet are available for all pressures, in a variety of styles which include offset, double union and jacketed valves. Inlet connections are available in five styles, including union, flanged, socket welding, solid shank and spherical union.

The valves are made for severe service, can be repacked under pressure, have renewable seats, and are available in special metals and with special packings, the company reports. Valve trim is standard in stainless steel with carbon steel valve body and forged yoke, nuts, rustproofed. **—K–28**

Anion Bed Support

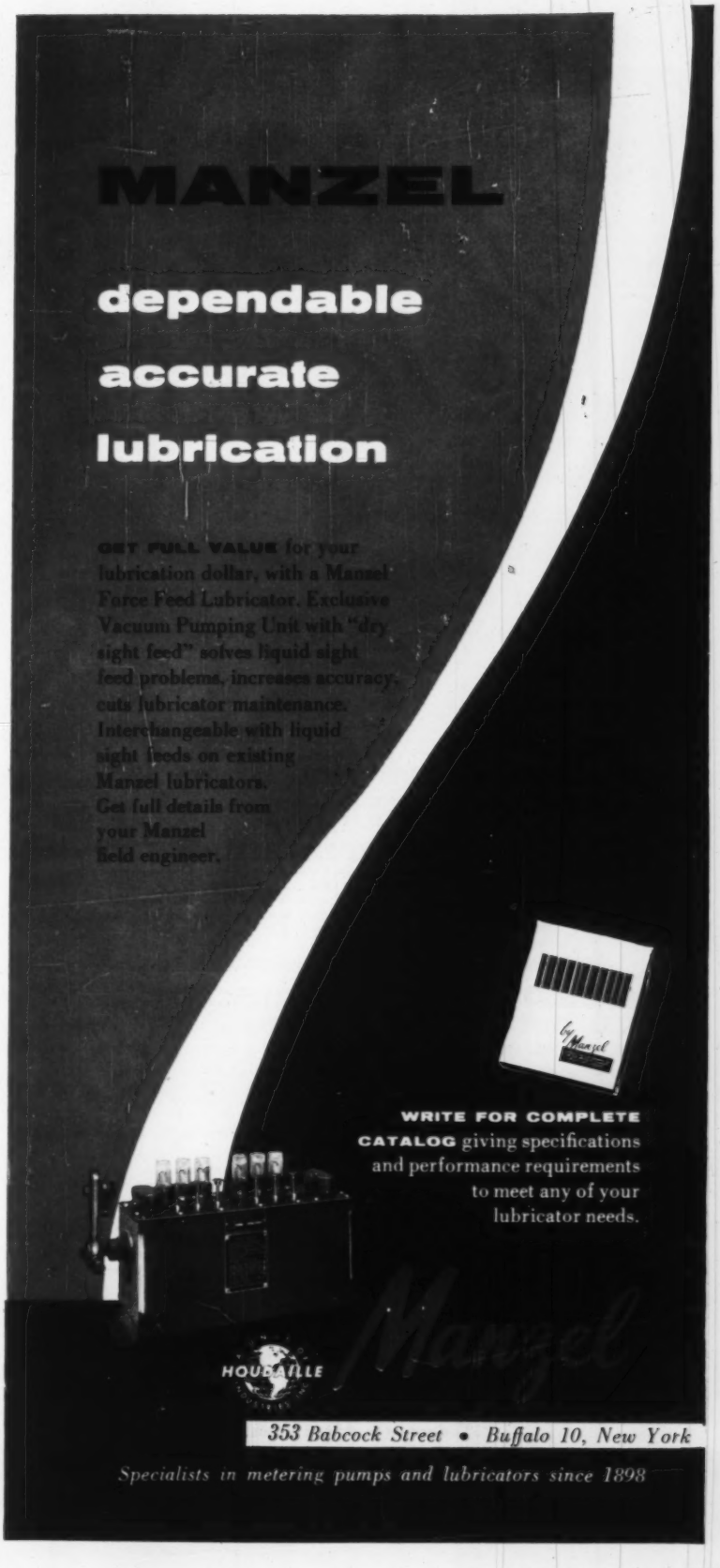
An anion unit bed support that eliminates the need for subfill media and substantially reduces final anion unit rinse requirements is available from Graver Water Conditioning Co.

The firm say the design provides for the replacement of subfill media by specially designed anion unit lower internals. These lower internals, similar to those used in mixed-bed demineralizers, incorporate a unique corrosion resistant bed support medium which allows the passage of water in either direction while retaining the resin. The bed support also provides for uniform collection and distribution over the entire cross sectional area. **—K–29**

Clutch Tension

Development of a new method of accurately setting clutch tension in steel strapping tools has been announced by W. C. Dillon & Co. The new technique involves use of the firm's traction dynamometer.

The dynamometer is firmly anchored to one end of a sturdy table. A length of steel strapping is secured to the dynamometer and anchored to a grip at the opposite end of the table. The strapping tool is then applied and cranked until the dynamometer reading agrees with a pre-determined clutch load for the tool. The clutch is then permanently set. Each tool is adjusted to specific job tension needs, with tension varying from 500 to 1600 lb, the firm reports. **—K–30**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The Manual is being published in seventeen sections, of which the following are now available. If you are not using them, it will pay you to do so, for with their aid, mistakes can be eliminated, efficiency increased, and the best type of workmanship produced.

SIZE AND FORMAT (Section 1), Y14.1 — 1957. $1.00

Deals with sheet sizes; the basic format; location of title and revision blocks, positioning of lists of material and drawing numbers, and print fold. Illustrated.

LINE CONVENTIONS, SECTIONING AND LETTERING (Section 2), Y14.2 — 1957. $1.50

Scope: Line symbols; visible and hidden lines; section, center and dimension lines; extension lines and leaders; cutting plane lines; break and phantom lines; section lining on detail and on assembly drawings; direction and spacing of general purpose section lines; the cutting plane; full and half sections; location of sectional views; lines behind the cutting plane; broken-out, revolved, removed, offset, auxiliary, and thin sections; sections through webs, shafts, bolts, pins, foreshortened projections and rotated features; intersections in section; sizes of lettering for different purposes. Twenty-seven diagrams supplement and illustrate the text.

PROJECTIONS (Section 3), Y14.3 — 1957. $1.50

Covering arrangement of views for multiple-view orthographic projections, this Section describes and illustrates practices in the choice and arrangement of the views; use of partial, alternate, removed and revolved views; auxiliary views; conventional breaks; and rounded and filleted intersections; developed views; descriptive geometry applications.

PICTORIAL DRAWING (Section 4), Y14.4 — 1957. $1.50

Here the various kinds of pictorial drawings are defined and the correct method of using them described. Axonometric, oblique, and perspective drawings are fully considered, and a number of examples presented showing the variety of positions in which the axes may be placed. Suggestions are given on the proper pictorial arrangement of sectional views, thread representation, the use of break lines, indicating fillets and rounds, unidirectional and pictorial plane dimensioning, shading, and phantom drawing.

DIMENSIONING AND NOTES (Section 5), Y14.5 — 1957. $2.00

Defines terms used in dimensioning drawings; illustrates how dimensions and notes should be used to specify design requirements on mechanical drawings, and includes dimensioning practices for the control and form tolerancing of geometric surfaces.

SCREW THREADS (Section 6), Y14.6 — 1957. $1.50

Presents the approved methods of placing screw thread data on drawings and a considerable amount of information on thread tolerances useful to draftsmen. Typical drawing notes are shown along with specific practices for dimensioning.

GEARS, SPLINES, AND SERRATIONS (Section 7), Y14.7 — 1958. $1.50

Although this Section is not intended to be a text book on gear design, it does give reasons for the methods shown and specified, so that the user will have some basic understanding of the need for more detailed gear-tooth dimensioning and specifications. Also included are the delineation and specification of Splines and Serrations.

FORGINGS Section 9), Y14.9 — 1958 $1.50

This document represents the best judgment produced by years of experience in forging, and will supply the needs of the draftsman who must transform a design sketch into a production drawing.

PLASTICS (Section 11), Y14.11 — 1958. $1.50

With the increasing applications of Plastic in industry, this Section should prove extremely useful in the drafting room. It gives recommended practices in the representation and dimensional sizes of various features which must be incorporated in drawings.

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Mercury Diffusion Pump

A rugged, all metal 2-in. mercury diffusion pump said to have a higher limiting forepressure than many larger mercury pumps, has been introduced by Rochester Div., Consolidated Electrodynamics Corp. It is claimed to be the smallest pump in the only metal mercury diffusion pump line in the United States.

Designated MHG-40, the water cooled, three-stage pump establishes its limiting forepressure because of the higher boiler pressure brought about by the low boiling point of mercury.

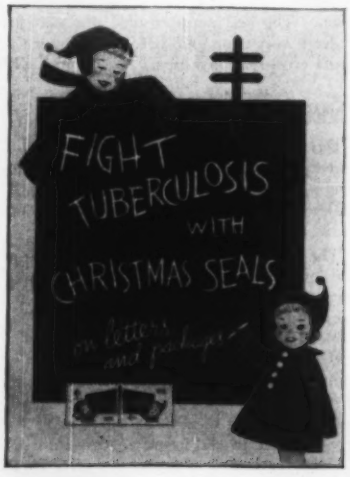
The use of mercury eliminates the possible presence of organic vapors which could cause serious organic contamination in a vacuum system. The unit can maintain a speed plateau of at least 40 l of air per sec in the 3×10^{-4} to 2×10^{-2} mm Hg pressure range with a peak of 52 l per sec occurring at 10 μ. An ultimate pressure of 1×10^{-8} mm Hg may be attained with a cold trap at −63 C. Throughput as high as 750 μ-l per sec has also been achieved, the company states. **—K-31**

Shaft Mounted Drive

Falk Corp., announces a new size 315GJ all-steel shaft mounted drive, with increased torque rating of 41,000 lb-in. at the low speed shaft.

With a ratio of 25:1, the unit covers a range of applications from 3 hp at 5 rpm to 30 hp at 50 rpm. Features include extra-depth, high pressure angle helical gears with 12–15 per cent greater load carrying capacity and mechanical efficiency than ordinary helical gears.

The unit has all-steel three-wall housing to maintain rigid alignment of revolving elements and to withstand external impact, inspection covers to check gears and bearings, dipstick for quick check of oil level. **—K-32**



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BUSINESS NOTES
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Numerical Control Systems

Manual feed rate override that permits the operator of numerically controlled machine tools to vary cutter feed rate from that programmed on the control tape is now available as a standard feature of the numerical control systems built by the Industrial Controls Section, Bendix Aviation Corp.

The firm says this feature eliminates the necessity of remaking machine control tapes to provide reduced tool loading in critical areas where variables such as cutter quality, material hardness, vibration from fixture or tool or incorrect feed rate programming cannot be taken into account. Feed rate override may be exercised at any time during the machining cycle without affecting the accuracy of the finished part, the company reports.

A control is provided with the numerical control system which permits the machine operator to reduce the feedrate from the programmed rate, 100 per cent, down to as little as 20 per cent of the programmed rate. —K-33

Tank Capacity Calculator

A slide rule calculator for determining capacity and size of storage tanks is available from Hammond Iron Works.

The calculator provides information on tanks up to 100 ft high and 300 ft in diam. Capacities are given in gallons, barrels, and pounds of water. Additional information obtainable includes decimal equivalents of a foot for all inch units and fractions; equivalent volumetric units; and steel plate weights for thicknesses from $^3/_{16}$ to 1 in. —K-34

Electronic Transducer

Development of an optical-electronic device capable of automatically detecting and recording angular change to within $^1/_4$ second of an arc is announced by Keuffel & Esser Co.

Called an electronic tilt angle transducer, the instrument can be used to measure positional disturbances of structures such as guided missile launching platforms and radar tracking systems, the firm states. —K-35

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Air Tools

A new series of Keller air tools, designed for drilling or assembly operations in close quarters, has been announced by Gardner-Denver Co.

The new angle drills, nut setters, and screw drivers are tailored for minimum clearance applications. The range in weight is from $2^1/_4$ to $3^3/_8$ lb, and are constructed with ball bearings. Zerol bevel gears and splined drives are used.

All three have flush grease fittings, efficient motor and attachment muffling, and control levers that may be adjusted in any relation to attachments to meet the special requirements of particular operating positions, the firm states.

Each tool is available in five sizes with speeds ranging from 3200 rpm for smallest sizes to 450 rpm for the largest size. Basic motors used in the three tools are identical. **—K-36**

Dial Thermometers

A redesigned line of indicating dial thermometers for measuring temperatures in the range of −350 to +1000 F is announced by U.S. Gauge Div. American Machine and Metals, Inc.

The new thermometers bear the tradename Supertherm.

The new line has variations of remote or direct reading types; methods of ambient temperature compensation, where required; filling mediums for different temperature ranges and uses; case sizes, materials, and styles; thermometer bulbs of different sizes, shapes, and materials to suit application needs.

Remote reading models employ conventional armored capillary tubing to connect the temperature sensing bulb to the dial indicator which can be up to 125 ft from the bulb.

Direct reading styles, wherein the thermometer bulb is closely coupled to the dial indicator, include a rigid stem type and multi-angle type. **—K-37**

Check Valve

A new controllable check valve, which requires low mechanical force to unload has been announced by the Fluid Regulators Corp.

The firm says the spring loaded check valve permits free flow in one direction and checks reverse flow until it is unloaded by depressing the external plunger.

The valve requires 100 lb maximum pressure to unload with 3000 psi on the checked flow part. With a 25 gpm flow at 3000 psi, the pressure drop is 65 psi maximum in the free flow direction and 35 psi maximum in the checked flow position. It has zero external leakage and low internal leakage, measured in drops per hour with 3000 psi at checked port.

The valve weighs $3^1/_4$ lb. Proof pressure is 4500 psi; burst pressure 7500 psi. **—K-38**

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Extruding Machine

A new extruding machine announced by Jennings Machine Corp., is said to produce Teflon-insulated wire at speeds three times faster than before.

Known as the TE-1A Teflon extruding machine, the new unit handles wire through triple-pass vaporizing and sintering ovens to increase extrusion speed three-fold without adding to oven length, the firm reports. Optional oven set-ups also allow single-pass handling for best quality and efficiency. Should the wire break, restringing is a minor job because saddles on each sheave prevent the wire from dropping.

Improved production flexibility results from the use of easily interchangeable extruder cylinders in sizes of 1, $1^1/_2$, 2, $2^1/_2$ in. and larger, the company states. Thus any wire size can be accommodated, with reduction ratios always in proportion. —K–39

Nylon Gear Coupling

A lightweight, non-lubricated, flangeless, flexible gear coupling with a one-piece nylon sleeve has been marketed by Sier-Bath Gear & Pump Co.

Called Nyflex, the new unit weighs $3^1/_2$ lb and is capable of operating over a wide temperature range at speeds up to 5000 rpm.

The new coupling is presently available in a selection of ten bore sizes ranging from $^7/_{16}$ to $1^5/_8$ in. The firm says the unit can take more misalignment than standard gear couplings. The unit will absorb both angular and parallel misalignment and end float with a minimum of backlash, and has been run for more than 800 hr at total misalignment with no signs of wear.

It is designed to be used on portable motor generating sets, motor pump sets, as a replacement for chain-type couplings and for many applications where a size $1^1/_2$ standard steel coupling is now used. —K–40

Roof Ventilators

A new line of rugged, low-profile, low-speed centrifugal type roof ventilators with non overloading wheel and spun streamlined inlet complete with large access door, motor and V-belt drive is now available from American Standard, American Blower Div.

Designated Model CR centrifugal roof ventilator, the new line includes 13 basic ventilator sizes with various motor and drive combinations resulting in 111 catalog sizes. Each size is sound-rated to suit specific building environments and provide a multiple selection of capacities and quietness ratings for any type building requirement.

Capacities of the new line of units range from 1120 cfm to 34,440 cfm at free delivery to 26,540 cfm at 1-in. wg static pressure. All units have been tested and rated in accordance with Standard Test Code for centrifugal and axial fans adopted by Air Moving Conditioning Association. —K–41

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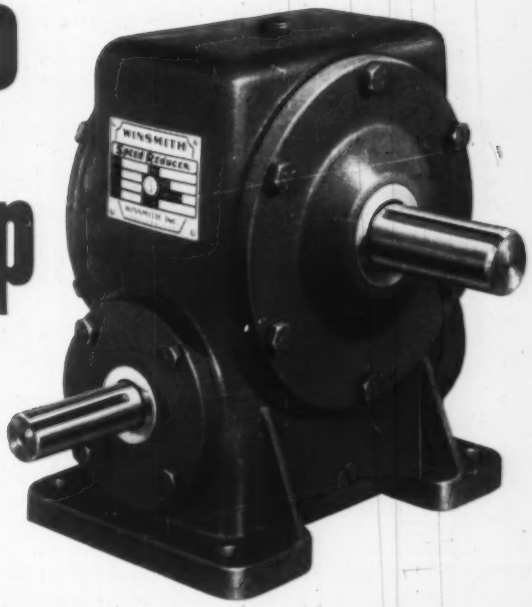

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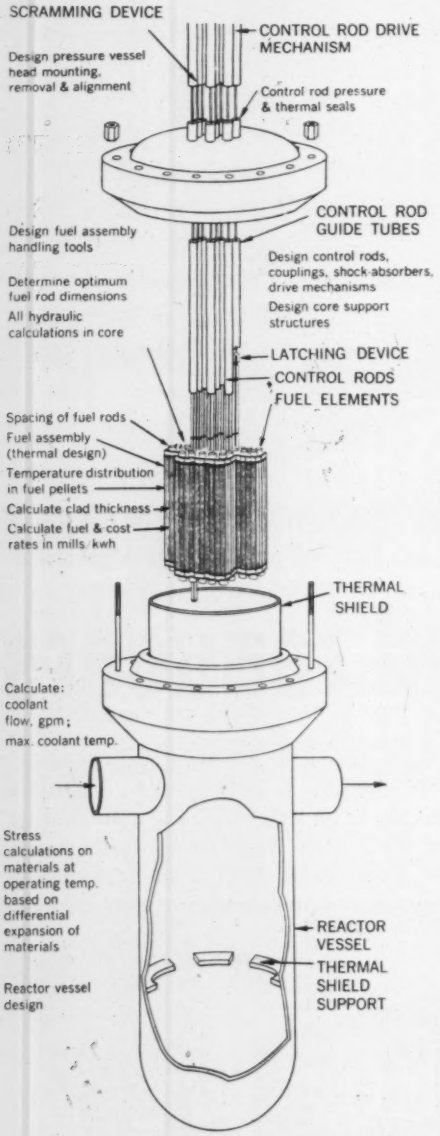
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Determine optimum fuel rod dimensions
Design core support structures
All hydraulic calculations in core
LATCHING DEVICE
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FUEL ELEMENTS
Spacing of fuel rods
Fuel assembly (thermal design)
Temperature distribution in fuel pellets
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Calculate fuel & cost rates in mills/kwh
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Extruded Aluminum

Aluminum Co. of America announces availability of extruded shapes with increased mechanical properties to achieve lighter, stronger parts for aircraft and missiles.

The firm says an advance in fabricating techniques has boosted the minimum guaranteed tensile and yield strengths for extruded shapes in alloy 7075-T6. The increase applies to extrusions with a cross-sectional area of 20 sq in. or less, in thicknesses ranging from .250 in. to 4.499-in. **—K-42**

Relief Valve

Watts Regulator Co., announces two new ASME rated self-closing temperature and pressure relief valves.

Designated No. 141S and No. 141X, both have male inlet and $\frac{3}{4}$ in. female outlet connections. No. 141S is equipped with lever and short thermostat while No. 141X is equipped with lever and extension thermostat.

Both valves are of all bronze construction and have a steam pressure discharge rating of 1,028,000 Btu per hr at 125 lb setting and AGA temperature water rating of 750,000 Btu per hr. **—K-43**

Digital Encoder

Precise, multi-positional reporting can now be accomplished with a new, miniaturized, 10-bit shaft position-to-digital encoder that features high resolution and eliminates ambiguity, it is reported by Librascope, Inc.

Indicating wide application in computer control of automatic machinery, the new encoder translates analog shaft position to true binary digital information. When complemented by auxiliary self-balancing potentiometers or servo equipment, the encoder is capable of reporting on a wide variety of analog data, the firm states.

Ten-bit resolution is obtained with a $3\frac{1}{2}$-in. disk that yields 1024 discrete position representations per turn. Its design permits the control of linear machine feeds to within tolerances of 0.001 in. of the total travel.

Overall size of the encoder is $4\frac{3}{16}$ in. in diameter by $1\frac{1}{4}$ in. thick. The shaft is fitted with a synchro-type mount to facilitate precise location of the input shaft. Voltage requirements for the transistors are −6 volts d-c. Life of more than one million revolutions can be expected with an input shaft speed of up to 25 rpm, the firmr eports. The instrument will operate over a temperature range of −50 to 150 F. **—K-44**

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K-4	K-14	K-24	K-34	K-44	K-54	K-64	K-74	K-84	K-94
K-5	K-15	K-25	K-35	K-45	K-55	K-65	K-75	K-85	K-95
K-6	K-16	K-26	K-36	K-46	K-56	K-66	K-76	K-86	
K-7	K-17	K-27	K-37	K-47	K-57	K-67	K-77	K-87	
K-8	K-18	K-28	K-38	K-48	K-58	K-68	K-78	K-88	
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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Truck-Cranes

Three new truck-cranes, capable of handling up to 200 ft of boom and jib, have been announced by Link-Belt Speeder Corp.

The 40-ton HC-108A will lift and handle, unassisted, 200 ft of the optional "Hi-Lite" tubular boom and jib, while the 35-ton HC-98A and 30-ton HC-88A handle 180 ft and 160 ft respectively. A 12-page catalog for each model covers the details of standard or optional features. —K-45

Adjustable Speed

A new simplified design, stationary control adjustable speed sheave, called Adjustex, has been introduced by Allis-Chalmers.

The sheave is available for A, B, and C section belts in two, three and four-groove construction. Pitch diameter sizes parallel the firm's former Vari-Pitch sheaves. One new diameter for C section belts—7.5/9.7 in. pitch diameter—is available for higher speed and wider speed range applications. Design capacities to 75 hp are covered by 33 sizes.

Adjustment is made through a single adjusting screw and a hollow lock screw. Relative position between stationary and movable disks is positively maintanied at all pitch diameters without disk to main sleeve set screws, the company states. —K-46

Thin Metal Fastening

High-strength, load-bearing threads can put into thinner gage sheet metal with lower installation pressures with a new self-swaging clinch-type nut developed by Standard Pressed Steel Co., Jenkintown, Pa.

Called the swage nut, the female-threaded fastener can be firmly anchored in sections as thin as 0.020 in. or as thick as 0.250 in. or more, the firm reports.

Installation pressures in steel, brass, Monel, aluminum and similar metals are as much as 50 per cent lower, the company claims. The new steel nut can also be swaged into harder sheet metal up to a Rockwell C-scale hardness of 25. —K-47

Barrel Finishing Equipment

Vibration-free operation characterizes a new line of precision barrel finishing equipment known as the Model 30 series manufactured by the Techline Div., Wheelabrator Corp.

The unit has a molded fiberglass safety gate, full-opening doors on the cylinder, doors sealed by special cam locks which operate on only 90 deg of turn, exerting high-compression pressure on the Neoprene door seals.

Power transmission is by an exclusive V-belt drive which is noiseless, the firm states. The equipment also features safety controls to prevent the machine from operating with the gate open except for jogging and a fiberglass housing which guards the entire drive mechanism. —K-48

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BUSINESS NOTES
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LATEST CATALOGS

Quartz Thread

General Electric has announced development of a quartz thread, said to be one of the most heat-resistant materials on earth for its weight.

Gossamer-thin, continuous monofilaments of fiber, made from pure quartz, have been successfully twisted into thread and woven into cloth on textile equipment, according to the G. E. Lamp Glass Dept.

Quartz thread, in the form of cloth, may be used to reinforce plastics now widely used in aircraft and missiles, and would greatly improve strength-to-weight ratios and increase the potential pay-load of space vehicles, according to the firm.

The company foresees a wide range of possible commercial and industrial applications for the new quartz thread and cloth including such uses as filters, thin insulation in flexible or irregular form, safety devices and heat-resistant plastic structural forms for industry, machinery, and building. However, the properties of quartz that make it of great value as a product, cause difficulties in manufacture that result in a price many times that of ordinary fiber, company said.—K-49

BUSINESS NOTES

Acquires Boiler Company

Cleaver-Brooks Co., manufacturer of packaged boilers, has acquired the 68-year old Springfield Boiler Co., Springfield, Ill.

According to the company, the transaction necessitates the investment of $1 million by Cleaver-Brooks, $500,000 for the purchase of the business with an additional $500,000 to cover working capital requirements.

French Bearing Plant

Timken Roller Bearing Co. announces that a modern plant for the manufacture of tapered roller bearings will be built at Colmar, France.

Formalities of the merger between the Societe Anonyme Française Timken, Service Français du Roulement and The Timken Roller Bearing Co., Div. Francaise, became effective November 1, 1958. The new plant will be in addition to the bearing factory located in Paris. Colmar is located in Eastern France near the point where the boundaries of Germany, France, and Switzerland meet.

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

New Warehouse

Chain Belt Co., announces the opening today of a new district sales office and warehouse at 10488 Chester Rd., Cincinnati. The new warehouse will provide facilities and services in Ohio, Kentucky and Indiana region.

LATEST CATALOGS

Glassed-Steel Testing

The Pfaudlertron, a new, constant voltage electronic tester designed for nondestructive testing of surface continuity in glassed-steel equipment, is the subject of Bulletin 970, now available from Pfaudler Co., Div. of Pfaudler Permutit Inc.

The new tester was designed to assure maximum life for glassed-steel equipment used in high corrosion applications. It is said to be the first completely electronic instrument specifically engineered for field testing glassed steel equipment. **—K-50**

Pile Hammers

Vulcan Iron Works Inc. has issued a new 20-page, engineering bulletin on the selection and application of single-acting pile hammers, using steam or air, with rated striking energy from 7260 to 30,225 ft-lb.

The bulletin deals with rating of hammers, selecting size required, safe bearing load for piles, adaptability for driving, bases, plates, driving heads, helmets, head blocks.**—K-51**

Single Stage Centrifugals

Bulletin 165, describing single stage centrifugal compressors for petrochemical and refinery applications, is announced by Clark Bros. Co. Two types are presented: Series OM for low pressure air service, and Series OPB for gas applications plus high pressure air. Capacities range from 1200 to 80,000 cfm. Input horsepowers vary between 10 and 2500 bhp. Details are given on casings, bearings, seals, impellers, lubrication system, baseplates, couplings, and recommended applications. **—K-52**

Filter Valves

A four-page technical bulletin W-17, describing surface wash water valves for filters has been published by Golden-Anderson Valve Specialty Co.

The control valves are also used for controlling the flow of water to the filters. They are easily opened or closed from the operating table in the usual manner, the firm reports. Operating layouts, operation, construction and dimensions are included, along with specifications. **—K-53**

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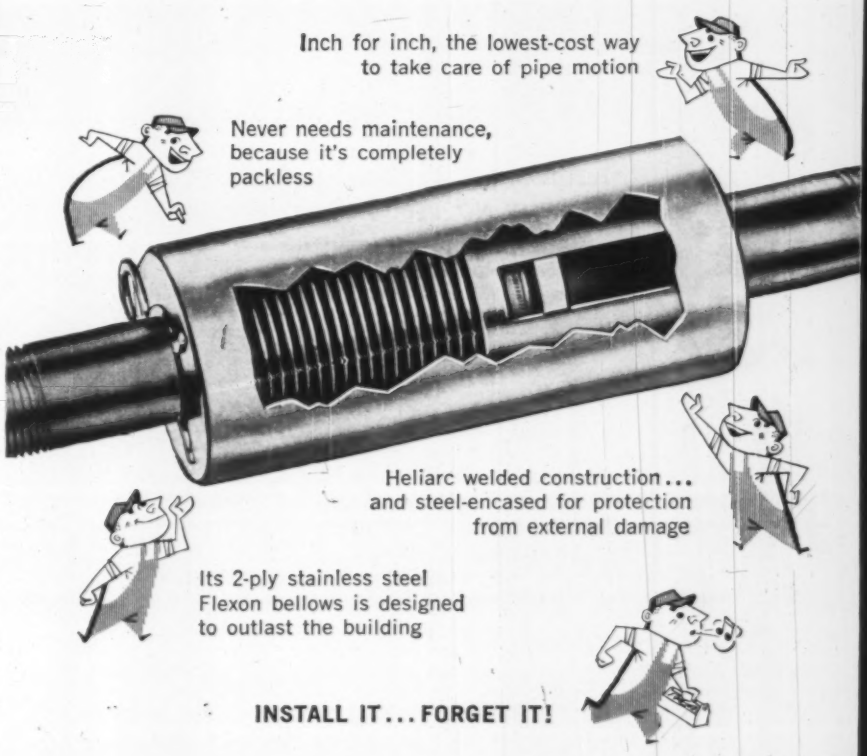
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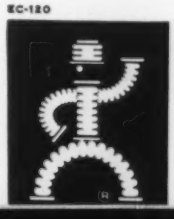

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NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Flame Hardening Castings

Test results on how different types of Meehanite metal react to flame hardening are included in a six-page technical article offered by Meehanite Metal Corp.

Information is designed to aid in making the right choice of metal for specific casting applications where increased resistance to wear and to surface breakdown is required. —K-54

Phosphating Compounds

CrysCoat No. 89, an iron phosphating compound that cleans and phosphates metal at the same time, and CrysCoat HC, a zinc phosphating compound designed to give a heavy coating in tank application, are the subjects of two folders published by Oakite Products, Inc. —K-55

Hydraulic Cylinders

Bulletin JH-104N, covering the hydraulic cylinders is announced by Miller Fluid Power Div. Flick-Reedy Corp.

It contains descriptive information on the firm's new Model J hydraulic cylinders for 500–2500 psi service and Model H cylinders for 3000–5000 psi service. Charts and descriptive data on column strength, piston rod deflections, acceleration, factors of safety, cylinder forces, pressure losses in pipes, factors to consider in selecting cylinders are included. —K-56

Motorized Gear Drive

Louis Allis Co. has published a four-page bulletin, No. 2350, on its new Line-A-Spede motorized gear drives.

The drives are gear reducers powered by standard NEMA frame motors mounted on a shelf attached to the reducer. The bulletin illustrates how the unit facilitates standardization of motors to reduce inventory and permits rapid motor changes. Construction features are illustrated in a cutaway, and engineering specifications and dimensions are given. —K-57

Air Control Valves

Bulletin F-44 describing its No. 234-L two-way air control valve is available from OPW-Jordan.

The bronze valve is used with air-operated hydraulic lifts, hoists, and other industrial air-operated equipment. It is manufactured with or without hold open feature in $\frac{1}{2}$ in. size. —K-58

Stainless, Low Alloy Steels

A 40-page booklet describing the investment-cast properties of eight stainless and four low alloy steels is available from Haynes Stellite Co., Div. of Union Carbide Corp.

The stainless steels include types 310, 316, 347, 410, 431 low-carbon, 431 high-carbon, and 440C. The low alloy steels cover 4130, 4140, 6150, and 1000 steel. These steels have been selected for their ability to meet wear, corrosion, high-temperature, and structural problems. They are also adaptable to the investment-casting method. —K-59

Assembly Tools

A 16-page catalog containing engineering dimensions and specifications for retaining ring pliers, applicators, dispensers and grooving tools has been published by Waldes Kohinoor, Inc.

Designated as Catalog No. AT 10–58, the new publication contains data on the company's 20 standard ring series, including recommended assembly tools for each ring type, and descriptions, size ranges and dimensions. —K-60

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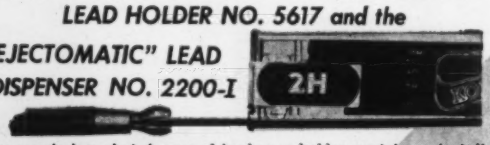

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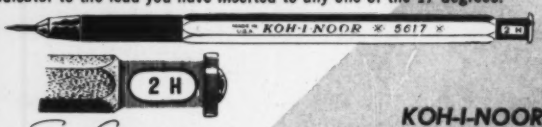

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BUSINESS NOTES
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Stainless Tubing

A bulletin published by Tubular Products Div., Babcock & Wilcox Co., explains how the use of the right type of stainless steel mechanical tubing will result in savings to the manufacturer.

Included in the bulletin are industry tolerance tables covering diameter, ovality, wall thickness, straightness, length, and machining allowances for both seamless and welded stainless steels mechanical tubing. The bulletin is identified as TB-365A. —K–61

Silent Stock Tubes

Silent stock tubes available in seven sizes for Brown & Sharpe automatic and hand screw machines are described in Bulletin SM 37 issued by the company. Noise created by the rotation of stock in ordinary stock tubes is said to be eliminated, thus improving working conditions. In the new unit, the bar rotates in a helically wound, wear-resistant steel liner that has no sharp edges to damage stock. —K–62

Tube Formulas

Formulas and tables for all flow and venturi tube applications are given in a technical bulletin issued by Builders-Providence, Inc., a Div. of B-I-F Industries, Inc.

Examples of formula application are worked out to determine such economic factors as the pumping cost per year for differential producers under typical conditions. The bulletin also contains dimensional tables, capacity tables, and performance charts. —K–63

Automatic Screw Driver

Performance of a new automatic set-screw driving device, called Setomatic, is reviewed in a new four-page bulletin from Standard Pressed Steel Co.

Said to be both a building block for fully automated production lines and an attachment for a single machine, the device automatically feeds, inserts, and tightens socket set screws ranging in diameter from No. 4 to $^3/_8$ in., in lengths up to $^3/_4$ in. Speeds up to 2500 installations an hour are possible, the firm states. —K–64

Materials Handling

Materials handling equipment manufactured by Heppenstall Co. are illustrated and briefly described in a new loose-leaf catalog.

The catalog includes automatic and motorized tongs for lifting material of any shape, weight, or size, as well as sheet lifters, rack lifters, motorized rotating hooks, C hooks and other hooks. The catalog shows nearly 100 items, ranging from tiny automatic tongs that weigh 1 lb each up to massive equipment designed to lift loads of many tons. —K–65

Worm Gear Drives

An eight-page, illustrated booklet providing information on worm gearing in general and pointing out the advantages of this type gearing is available from Cleveland Worm & Gear Co. —K–66

Bronze, Iron, Steel Valves

Ohio Injector Co. has issued catalog digest CD-2 illustrating and describing its line of bronze, iron, cast steel and forged steel valves.

Valves shown in cutaway drawings, and dimensions in table form. —K–67

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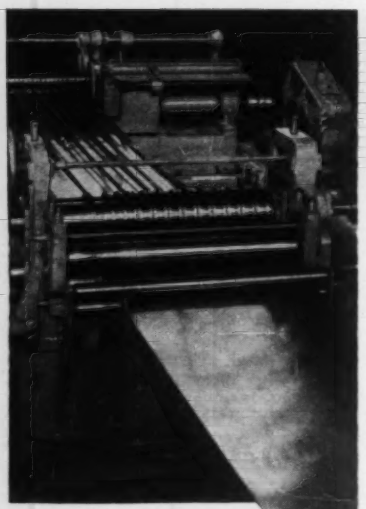

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Even if you use less than 100 tons of varied strip sizes per month, it will pay you to investigate the savings that are possible through the operation of a Yoder slitter. Savings per ton increase rapidly as coil size and width of strands decrease...so much, that under average operating conditions, a slitter will pay for itself in a few months.

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Steel-Plastic Pipe

A four-page pamphlet containing information about a newly-developed rigid plastic pipe encased in a steel jacket has been prepared by Jones & Laughlin Steel Corp.

The new product, known as "Jal-Jacket," is said to combine the pressure-retaining strength of steel with the chemical resisting qualities of unplasticized polyvinyl chloride. The pamphlet contains specifications, line drawings and other information. —K-68

Instrumentation, Equipment

Representative items from the line of process instrumentation and equipment manufactured by B-I-F Industries, Inc. are described in an eight-page bulletin. The bulletin contains photographs, operational data and design feature descriptions of 12 varied products for positive control of materials in motion. —K-69

Pumps, Fluid Motors

A 12-page catalog, No. 100, has been published by Tuthill Pump Co., to provide information on its line of pumps, fluid motors, and valves.

Internal gear pumps, sliding vane pumps and spur external gear pumps and fluid motors are described. Also covered are relief valves provided in sizes from $^3/_8$ to $1^1/_2$ in., Powermite pump and motor combinations, and Powermax fluid motors. —K-70

Cemented Carbides

A new catalog, on cemented carbides for industry is now being distributed by Carmet, the carbide producing division of Allegheny Ludlum Steel Corp.

The 32-page booklet includes, for the first time, all material that previously had been in five separate booklets. Included in the material is a new simplified pricing system. A new cutting grade, CA-604, is listed for the first time. —K-71

Remote Valve Controls

Stow Mfg. Co. has published a 20-page design manual on its manual remote valve controls. Design information on flexible shaft valve controls including valve couplings and remote operating terminals, is given. Also shown are standard reach rod controls including universal joints, valve couplings, and remote stations. The firm's new 300 deg swivel geared joint is also shown. —K-72

Castable Refractories

Plibrico Co. announces Bulletin No. 75, describing monolithic linings for full protection of stacks and breechings, utilizing castable refractories.

It covers structural and installation advantages of one-piece construction. Characteristics for five insulating grades of refractory recommended for this service, are given. —K-73

Hydraulic Components

Parker Hydraulics Div. Parker-Hannifin Corp. has issued a folder which reviews directional control valves, accumulators, cylinders, hose assemblies and tube fittings. —K-74

Steam Generators

Cyclotherm Div., National-U.S. Radiator Corp., has issued a folder describing its line of 18 sizes of package steam generators with a range of from 15 to 650 hp.

Specification sheets on the 10 sizes of the company's newly developed package hot water generators with a range of 670 to 6700 mbh are also included. —K-75

Regulating Valve

Bulletin 1053, describing its flow regulating valve said to offer two distinct advantages over ordinary control valves, is announced by Copes-Vulcan Div., Blaw-Knox Co.

The valve uses a horizontal rotating lever shaft instead of a sliding stem, and it is accurately balanced in service. The bulletin illustrates the features and other special characteristics of the valve, and gives specifications on sizes, pressures, and materials of construction. —K-76

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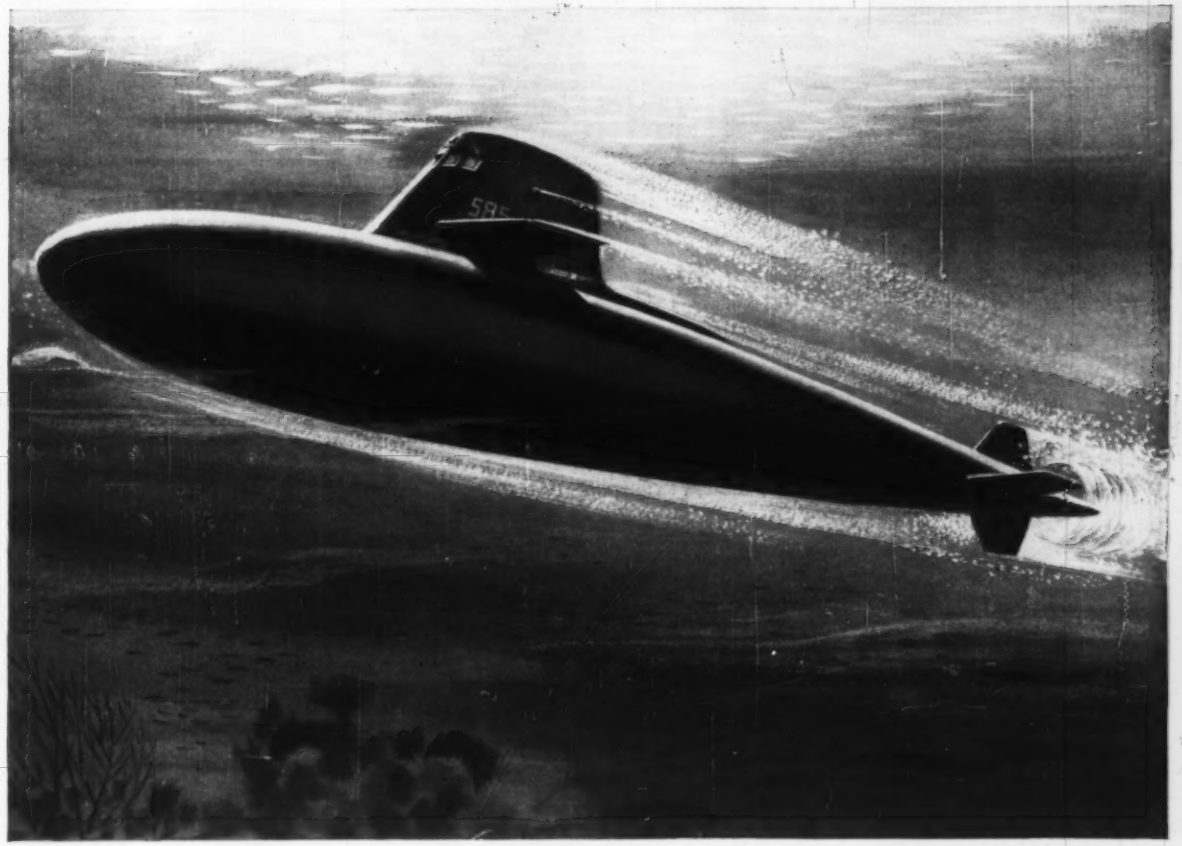

Sandusky cylinders help the Skipjack CRUISE, DIVE, STEER, BREATHE and FIGHT!

Centrifugally cast cylinders by Sandusky play vital roles in the U. S. Navy's newest atomic-powered submarine, No. 585 *Skipjack*, as components of the nuclear propulsion system, the steering and diving systems, the torpedo firing mechanism, and radar and induction mast assemblies.

The *Skipjack* is the prototype of a new series of seven submarines all with blimp-shaped hulls for greater underwater speed. Her design and materials specifications were laid down by the U. S. Navy and her builder, The Electric Boat Division of General Dynamics Corporation, who chose Sandusky Centrifugal Castings to do more than ten jobs in structural, mechanical, pneumatic, and hydraulic applications.

All of these components – centrifugally cast of heat and corrosion-resistant stainless steels, high-strength carbon steels, Monels, and bronzes–provided the *Skipjack's* designers with the required mechanical and physical properties at the lowest cost.

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Light or heavy-walled

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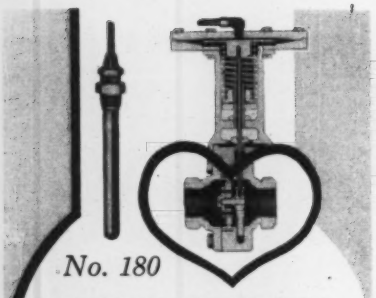

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Packaged Firing Systems

A four-color folder released by Iron Fireman Mfg. Co. describes industrial packaged forced-draft firing systems for dual-fuel or single-fuel firing of high or low pressure natural.

The systems are also designed for LP or manufactured gas or any grade of oil from No. 2 through No. 6 in Scotch marine, steel firebox, water tube or cast iron boilers. Included are illustrations and information on nine installations. **—K-77**

Stainless Tubing Fittings

A technical data card, no. TDC-189, published by Tubular Products Div. Babcock & Wilcox Co., tells of the high temperature properties of Croloy 16-13-3 (TP 316) for stainless steel tubing, pipe and welding fittings. Its chemical composition, size ranges, and short time tensile and rupture properties are discussed. **—K-78**

Ductile Iron Castings

A 12-page bulletin by Cooper-Bessemer Corp. provides data on application of ductile iron for machine parts.

Material specification and foundry facilities available for producing quality ductile iron castings to meet specific job requirements are covered in the bulletin, designated MPC. **—K-79**

Ventura Fans

An illustrated bulletin, No. 8914, describing its new, expanded line of Model IC ventura fans is available from American-Standard, American Blower Div.

Tables list 42 low-pressure fans and 50 high-pressure fans, giving fan speed, motor horsepower, quietness rating, and net weight as well as delivery over a range of static pressure values. Also included is a chart which explains the significance of the different quietness ratings. **—K-80**

Diesel Engine Controls

"Controls for Diesel Engines" is a new 24-page Minneapolis-Honeywell bulletin.

It describes temperature and pressure control systems for diesel engines, safety devices, tachometers, control motors, valves, switches, relays and related accessories. **—K-81**

Storage Vessels

Coordinated engineering, fabrication, and erection services offered by Chicago Bridge & Iron Co., are described in a four-page booklet which also illustrates storage and pressure vessels, Hortonclad and special alloy structures and the Horton pickling process. **—K-82**

Fiber Cartridge Filters

Depth-type fiber cartridge filters for full flow filtration of all types of fluids are presented in the new Micro-Klean catalog of Cuno Engineering Corp.

Information is given on the advantages of the firm's "graded density" cartridge construction. A selector chart, cartridge life curve, flow rate table, and other product performance information is included, along with dimension, weight, and installation data, line drawings and photos. **—K-83**

Steam Condensers

A 38-page condenser handbook offering simple methods of calculating steam condenser performance is available from C. H. Wheeler Mfg. Co.

The handbook contains basic formulas for calculation of condenser heat transfer coefficient, cooling water flow rate, condensing surface and other data, with complete explanations and sample calculations. Calculation short cuts are included. Curves and charts on condenser performance, heat transfer correction data, absolute pressure limit data, pressure loss in water boxes, friction losses in brass tubes, minimum capacities of air removal equipment are included. **—K-84**

1956 MANUAL OF CONSULTING PRACTICE FOR MECHANICAL ENGINEERS

A Guide for Consulting Engineers and Their Clients

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Power Transmission

Bulletin 3101, issued by T. B. Wood's Sons Co., covers the company's line of sheaves, variable-pitch sheaves, V-belts, flat-belt pulleys, pillow blocks, flange units, take-up bearings, couplings and timing-belt drives.

The bulletin also includes a postcard to aid for securing additional literature on specific items pictured or described in the complete-line bulletin. —K-85

Clutches, Couplings

A bulletin describing the uses of slip clutches and couplings on industrial machinery has been issued by Hilliard Corp.

The bulletin depicts some typical installations of the units on speed reducers, conveyors, gearing, and tension control. In each case, illustrations of these applications are shown. A listing of the range of sizes and styles is given. —K-86

Retaining Rings

A 24-page catalog containing descriptions and illustrations of all currently available retaining rings, pliers, and accessory tools has been published by Waldes Kohinoor, Inc.

The publication is designated No. RR 10-58, and includes selector guides to the company's 20 standard ring series and 30 representative special rings designed for individual customer requirements. Brief descriptions of the purpose and function of each ring type are given. —K-87

Cutting Machine

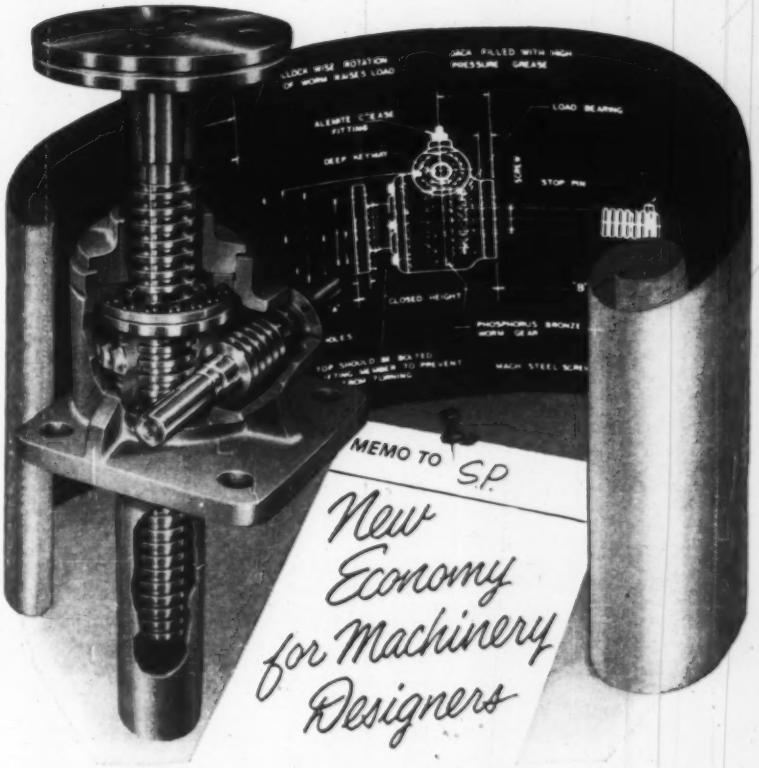
A four-page folder, DH-106, describing Model 1-A Sever-all dry abrasive cutting machine has been issued by the Allison-Campbell Div., American Chain & Cable Co.

The new cutter, according to the manufacturer, cuts solids up to 2 sq in., pipe and tubing up to $3\frac{1}{2}$ in. OD angle iron up to 3×3 in. and channels up to 4 in. Specifications such as rated capacity, power required, cutting wheel diameter, dimensions and weights are listed. —K-88

Rotary Swaging Machine

A brochure describing its new electro-hydraulic die closing rotary swaging machine is being offered by Swaging Machine Div., Torrington Co.

The new machine is designed to make reductions in diameter on rods, heavy tubes, or other parts such as aircraft control cable assembleis, which cannot be reduced by feeding into standard rotary swaging machines. With the die closing attachment, the work is placed in the machine in a predetermined position, and the dies which rotate around the work are brought in radially by means of hydraulically-operated wedges. The machine can be operated in the normal fashion, without wedges, by replacing the special backers and dies with standards parts. —K-89



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NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Stainless Steel Exchangers

Bulletin No. 301.6Kl issued by American-Standard, Ross Heat Exchanger Div., presents Type SSCF stainless steel exchangers for production and pilot plant applications of the chemical and process industries.

Included in the bulletin are details on features designed to assure maximum heat transfer, plus specifications on the 19 models available in one-, two-, and four-pass designs. —K–90

Servo Motors, Amplifiers

Ketay Dept., Norden Div., United Aircraft Corp. has issued a bulletin with specifications and outline drawings on synchro transmitters, transformers, receivers, and differential transmitters with stainless steel housings, thru-bore construction and torque gradients of 2400 mg mm/degree.

Size 8 servo motors which offer high ratio of stall torque to power input (0.025 oz in. for 3.4 w input) and size 8 amplifiers with a volume of 0.8 cu in., capable of delivering 2 w of continuous power output at 100 deg without a heat sink are covered. —K–91

Tubing End Seals

A paper on the appraisal and comparison of the various types of hydraulic cylinder tubing end seals is available from Miller Fluid Power Div., Flick-Reedy Corp.

Illustrations show five different types of end seal design, including gaskets, O-rings and the firm's new Shef seal construction. Descriptive copy compares the advantages and disadvantages of the various types. —K–92

Controlled Volume Pumps

Milton Roy Co., has published Bulletin No. 258 describing its new line of Milroyal controlled volume pumps with totally enclosed drives.

The bulletin describes the design features and provides specifications for the unit which is designed to provide highly accurate metering of chemicals against pressures to 1900 psi in adverse atmospheres. Its capacity can be adjusted in a direct linear relationship while the pump is running. —K–93

Special Fasteners

Detailed specifications, engineering drawings, applications and installation information is provided in a 40-page Simmons Fastener Corp. catalog.

Data on new Hinge-Lock and Spring-Loaded Link-Lock is given, as well as details on other special fasteners: Dual-Lock, Quick-Lock, Roto-Lock, Spring-Lock and the regular Link-Lock. —K–94

Magnetic Equipment

A bulletin offered by Stearns Magnetic Products summarizes equipment for protection against tramp iron such as magnetic pulleys; suspended magnets; drum, plate, grate and spout magnets and electronic metal detector.

Materials handling equipment like lifting, holding, and roadsweeping magnets; parts separators, hand magnets; portable drill stand magnets and grinder holding magnets are also shown. The booklet also details information on heavy-duty equipment for purification and concentration of magnetically responsive materials. —K–95

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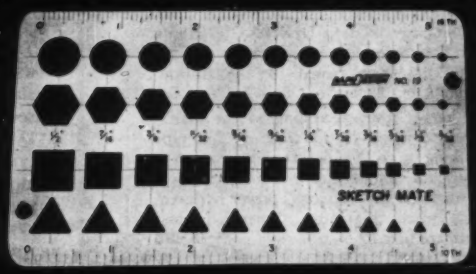

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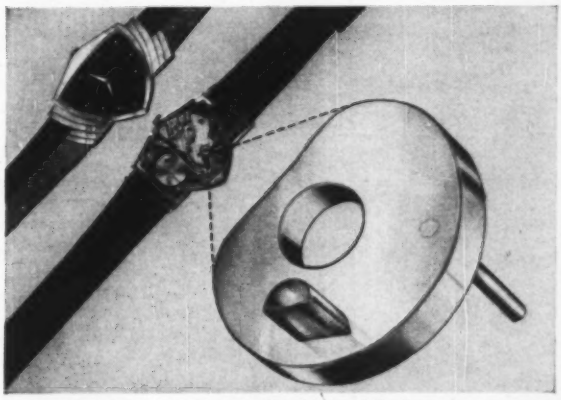
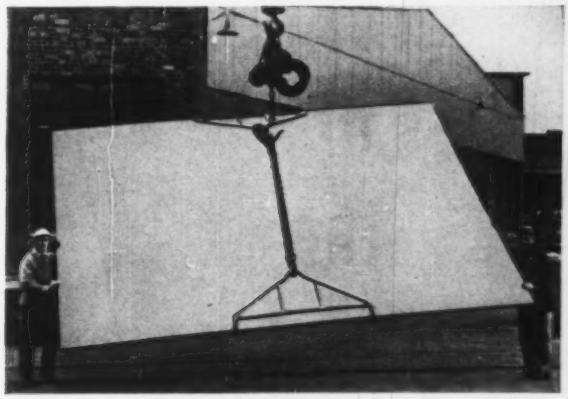
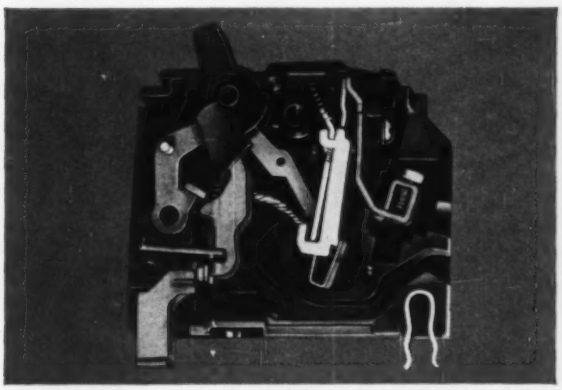


HAMILTON WATCH CO., for the world's first electric wristwatch, demanded these qualities in metal for a vital 1/7000-ounce indexing roller – high hardness and tensile strength; ease of blanking, machining; nonmagnetic properties. Anaconda Ambraloy-901 met the need perfectly. The magnified pinhead-size assembly shown above has a half-round sapphire jewel. The pin limits balance motion.



ALLIS-CHALMERS – building what may be the world's largest surface condenser for Commonwealth Edison Co. – needed tube sheets which combined strength and corrosion resistance with machinability. The answer was Anaconda leaded Muntz metal – 4 plates, each 13′ x 17′, 1½″ thick, weighing over 7 tons. When drilled, plates support 21,960 tubes, for 200,000 square feet of condensing area.



SQUARE D COMPANY needed low electrical resistance, high spring properties, fatigue resistance in critical parts (in color above) of their QO circuit breaker. Electrical resistance of ordinary phosphor bronzes was too high. So was the cost. Engineers of The American Brass Company suggested Anaconda Ambronze-474 and Square D found it had the right combination of properties for the need. And this metal provided superior forming and lower material costs.

THE TRANE COMPANY'S railroad air-conditioning "dry-wet" combination condensers are mounted under cars – facing severe corrosive conditions and a beating from roadbed gravel and stone. Exposed metal, including casing, liquid receiver, 170-gal. water tank, must have superior corrosion resistance, high strength and toughness. Trane has found Everdur®, Anaconda's group of copper silicon alloys, meets its needs. And Everdur is easy to fabricate.

Starting with 93 standard alloys, The American Brass Company can make minor variations in composition, fabrication, and annealing to provide an almost unlimited number of combinations of useful properties. When new or unusual problems rise, ask for the help of the Technical Dept. in selecting the right metal. For such help or a copy of Publication B-32, "Anaconda Copper & Copper Alloys," write: The American Brass Company, Waterbury 20, Conn. 5854

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June 10, 1958

When your company purchases the following types of products and services, do you have an influence in the purchase? Check below. (Influence = authorize, specify, decide, requisition, recommend, suggest or approve).

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Pumps	55.7
Pipes and Fittings	52.1
Instrumentation and control	55.9
Turbines	
steam generating	13.3
steam, mechanical drive	14.0
gas, mechanical drive	7.6
Boilers	25.9
Stokers	14.0
Materials Handling Equipment	37.1
Packing, gaskets	37.3
Power Transmission	
gears	36.1
chains	30.8
belts	33.3
couplings	39.4
speed reducers	37.5
Electric Motors	
fractional horsepower	33.9
medium	39.7
large	25.7
Heat exchangers	39.3
Dust & Ash Precipitators	18.8
Fans and Blowers	45.1
Refractories	23.2
Lubricants	34.1
Water Treating Equipment	28.5
Tanks, steel plate	30.5
Engines (internal combustion)	17.9
Expansion Joints	29.6
Machine Tools	27.7
Compressors	32.3
Insulation	37.3
Air Conditioning	30.0
Welding and cutting Equipment	26.9

PRODUCT COMPONENTS	%
Bearings	40.7
Power Transmission	
gears	30.6
chains	23.7
clutches	25.1
Instruments and controls	41.7
Metals	
ferrous	37.9
non-ferrous	36.7
Fasteners and springs	32.7
Electric Motors	
fractional horsepower	27.7
medium	23.6
large	15.0
Gaskets & O-Rings, seals	37.9
Hydraulic pumps and fittings	29.3
Tubing	33.1
Castings and forgings	31.2
Plastic parts	26.9

ENGINEERING TOOLS	%
Drafting Equipment	27.6
Computing and Analyzing Machines	
Electro-mechanical	13.6
Testing Equipment	25.9

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(2) The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;

(3) The development and operation of vehicles capable of carrying instruments, equipment, supplies and living organisms through space;

(4) The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;

(5) The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere;

(6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by such agencies, to the civilian agency established to direct and control nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency;

(7) Cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof; and

(8) The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment..."*

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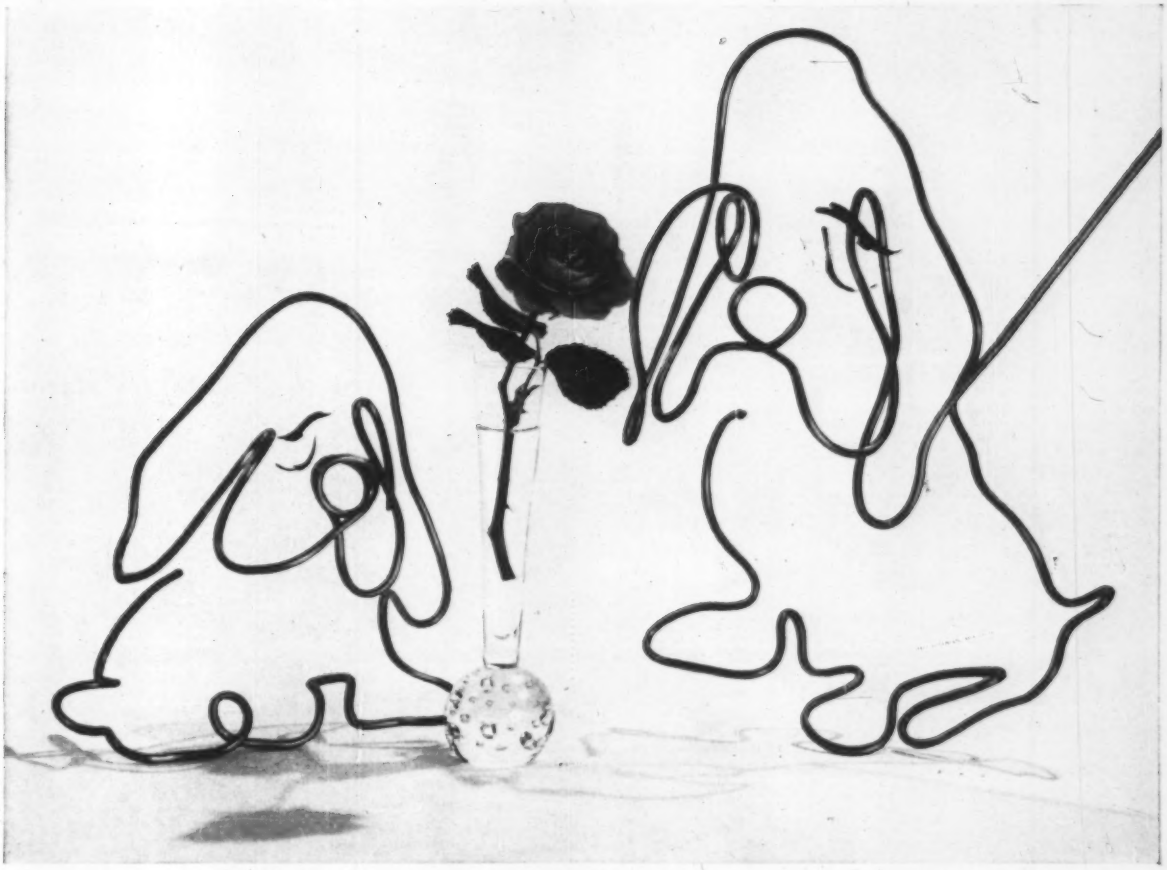

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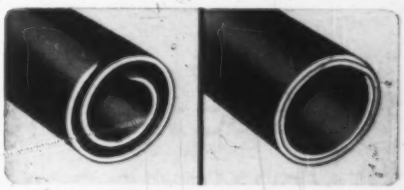

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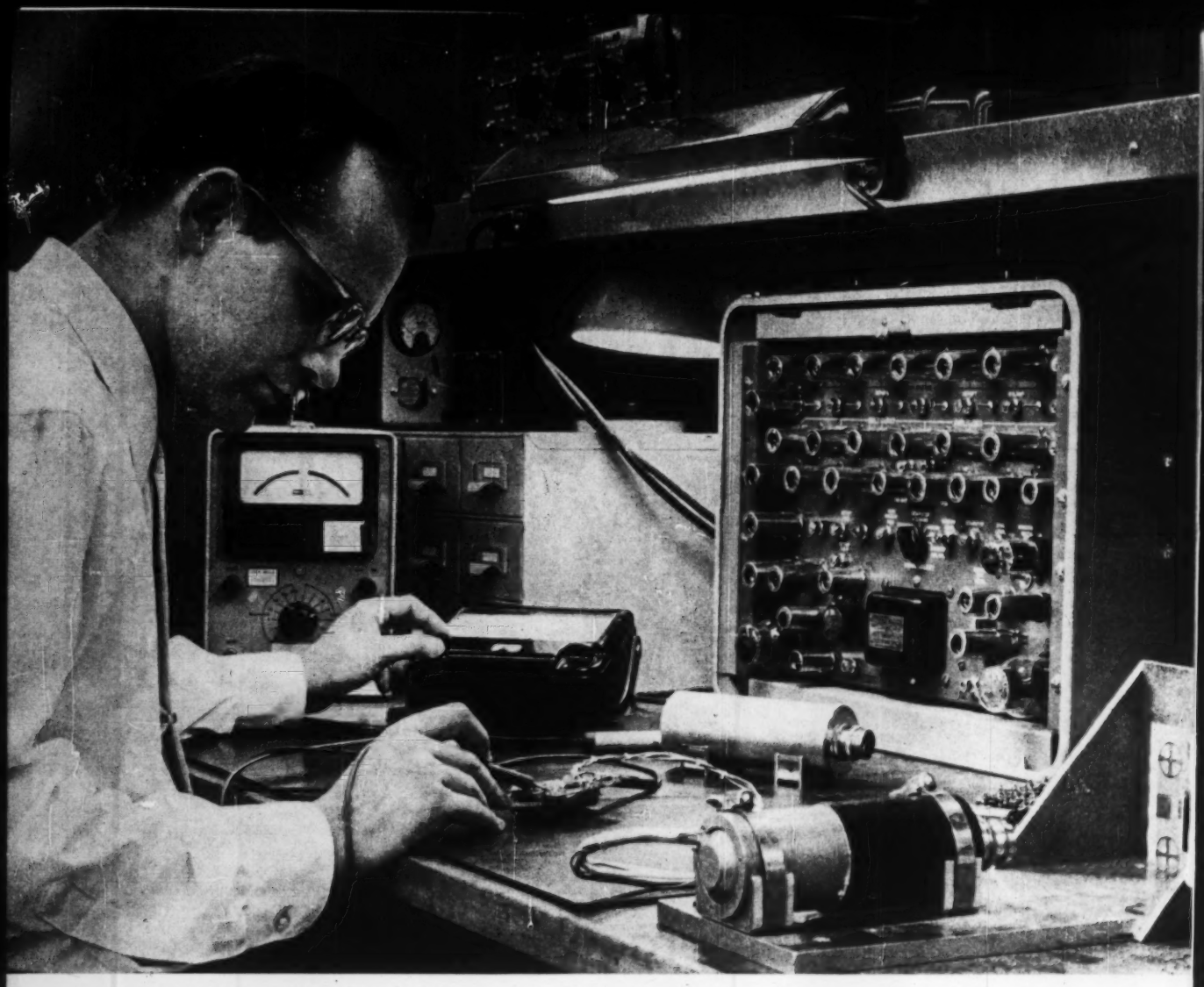

A MISSILE AND TELEVISION INDUSTRY FIRST. Lockheed-developed, miniaturized TV cameras, designed for both government and commercial use. Only 6 inches long and 2¼ inches in diameter, tiny cameras extend man's vision into the unexplored. Unmanned lunar probes to the far side of the moon; lunar landings; monitoring interiors of manned spacecraft and remote TV coverage of on-the-spot happenings on a scope never before possible are some of the uses foreseen for the cameras.

ELECTRONIC ENGINEERS AND SCIENTISTS

Lockheed Missile Systems Division is systems manager for such major, long-range programs as the Navy Polaris IRBM, Earth Satellite, Army Kingfisher, Air Force X-7 and Q-5 ramjet vehicles, and other important research and development programs.

Responsible positions for high-level, experienced personnel are available in research and development, in our project organizations, and in manufacturing.

Particular areas of interest include microwave, telemetry, radar, guidance, solid state, reliability, data processing, instrumentation, servomechanisms, flight controls, circuit design and systems analysis, test, infrared, and optics.

If you hold a degree and are experienced in one of the above fields, we invite your inquiry. Please write to Research and Development Staff, Dept. 4012, 962 W. El Camino Real, Sunnyvale, California.

Lockheed

MISSILE SYSTEMS DIVISION

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Positive Protection Against Phase Failure and Phase Reversal ?

Here is your answer!

The Allen-Bradley Bulletin 812 Type F, Type R, and Type RF relays provide positive protection against the hazards to men, motors, and driven machinery, resulting from phase failure and/or phase reversals.

The Bulletin 812 Style F phase failure relay employs a unique static sensing network that responds to all open phase conditions on a motor branch circuit and immediately removes the motor from the line . . . irrespective of the load on the motor (including no load), or the circuit arrangement. This relay even responds to hard-to-detect primary failures on a wye-delta transformer with ungrounded neutral. Furthermore, the five-cycle response prevents nuisance "drop-outs" from transient fluctuations.

The Bulletin 812 Style R phase reversal relay disconnects the motor from the line—whether it is running or not—when a phase reversal occurs anywhere in the system on the line side of the relay. Thus, it can be employed for a single motor, a group of motors, or an entire power system. In addition, the phase reversal relay prevents the motor from starting should phase failure occur while at a standstill—a vital feature for elevator applications.

The Bulletin 812 Style RF relay combines the elements of Style R and Style F relays for protection against both phase failure and phase reversal. All Bulletin 812 relays are inherently "fail safe." Send for complete information.

Allen-Bradley Co., 1316 S. Second St.
Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd.
Galt, Ont.

ALLEN-BRADLEY

QUALITY

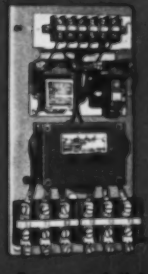
MOTOR CONTROL

12-58-MR

Bulletin 812, Style RF for Phase Failure and Phase Reversal

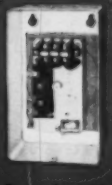
INDIVIDUAL RELAY UNITS AVAILABLE

For Phase Failure



Style F covers full load currents from 1.5 to 300 amp in 4 sizes. Coils for up to 600 v, 60 cycles.

For Phase Reversal



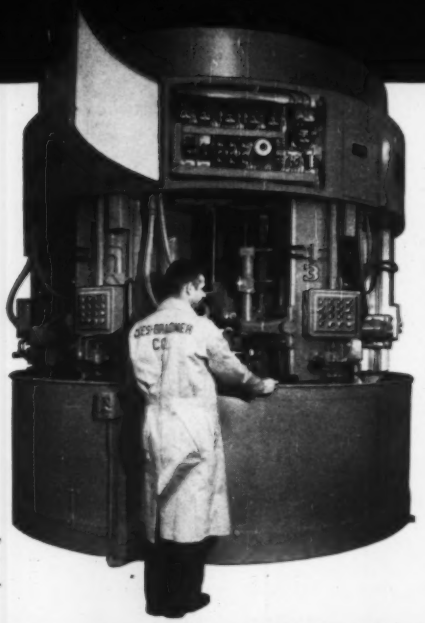
Style R made with coils for 110, 208/220, 440, 550 v for either 50 or 60 cycle operation.

"If we stick to ALLEN-BRADLEY... our control troubles evaporate"

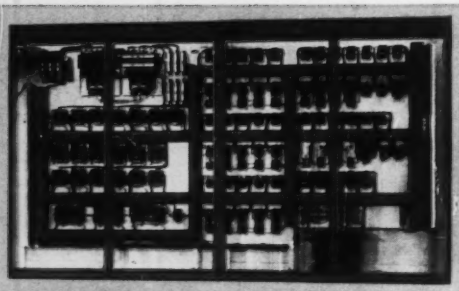
...so says John A. Bradner,
President, Lees-Bradner Co.,
Cleveland, Ohio, machine tool manufacturer.

"Yes, we have chosen Allen-Bradley controls. We use them, like them, and most thoroughly approve of them. We do our level best to see that they're the ones with which LEES-BRADNER machines are equipped.

"It has been our experience in over 25 years of pioneering electrical rather than mechanical control of machine tools that, if we stick to Allen-Bradley, control troubles we are too apt to have otherwise—*evaporate!*"



Lees-Bradner Gear Hobbing Machine, above, uses six motor control panels assembled from standard A-B components.



This is the electrical control panel for a 12-station Kingsbury Indexing Automatic which performs 19 operations on an automatic transmission part. All the components in this panel are standard A-B control items.

The 78 operations of a huge Buhr Automatic Transfer Machine are controlled by this "special" electrical panel. All the components are standard Allen-Bradley units.

A-B QUALITY

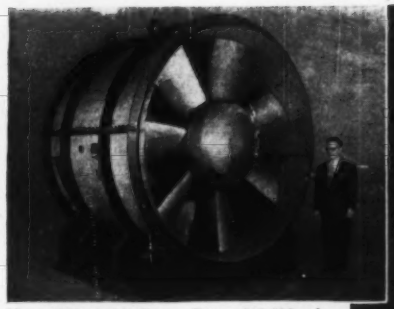
ALLEN-BRADLEY

MOTOR CONTROL

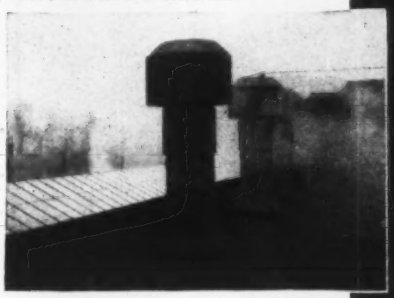
QUALITY

Allen-Bradley Co., 1318 S. Second St., Milwaukee 4, Wis. In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

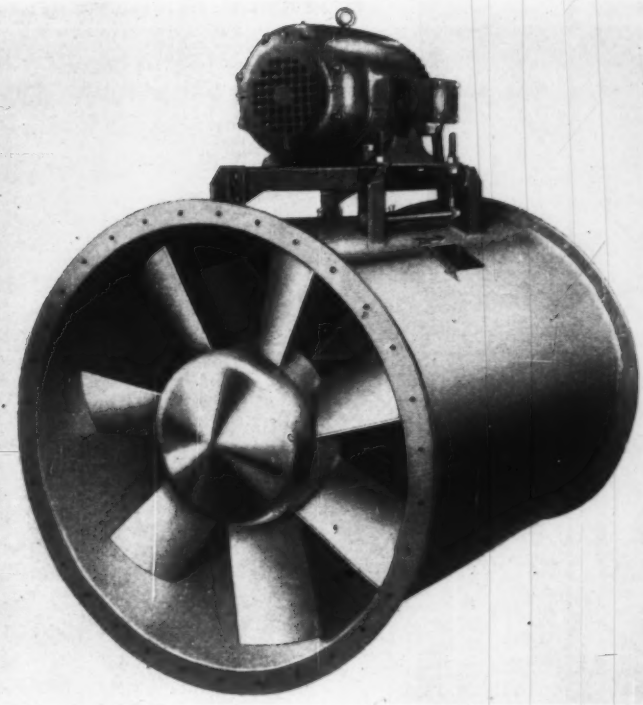
13-58-R



Huge 96" Acid Fume Fan—210,000 cfm "Buffalo" Axial Flow Fan with cast aluminum wheel, installed in a textile mill.



In Stack Hood Exhaust — Easy installation is a big advantage of the duct-size "Buffalo" Axials mounted in these stacks. Hoods give all-weather protection.



FOR TOP AXIAL FLOW FAN EFFICIENCY— IN BIG JOBS OR SMALL—

SPECIFY "BUFFALO" AXIALS

"Buffalo" Axial Flow Fans provide extremely quiet and efficient performance. This inherent efficiency is further improved by the "Buffalo" Vaneaxial outlet guide vanes. These carefully engineered vanes re-direct the swirling air at the fan outlet, converting it into increased forward thrust.

These sturdy, reliable fans are light in weight, permitting easy installation. Except for the largest models, no structural support or heavy foundation are required. "Buffalo" Axials can be installed as a section of the duct or stack in hood and other roof exhaust systems.

Duct-size "Buffalo" Axials save space by fitting in close to walls or ceilings. Space-saving installations include service as ventilation, exhaust and industrial air conditioning supply fans. They are widely used for applications ranging from paint spray booth exhaust to boiler room cooling.

"Buffalo" Axial Flow Fans are available for high or low temperatures, corrosive fumes, explosive atmospheres and other severe conditions.

Investigate the many advantages offered by "Buffalo" Axial Flow Fans. Contact your nearby "Buffalo" engineering representative, or write direct for Bulletin 3533-EF.

BUFFALO FORGE COMPANY

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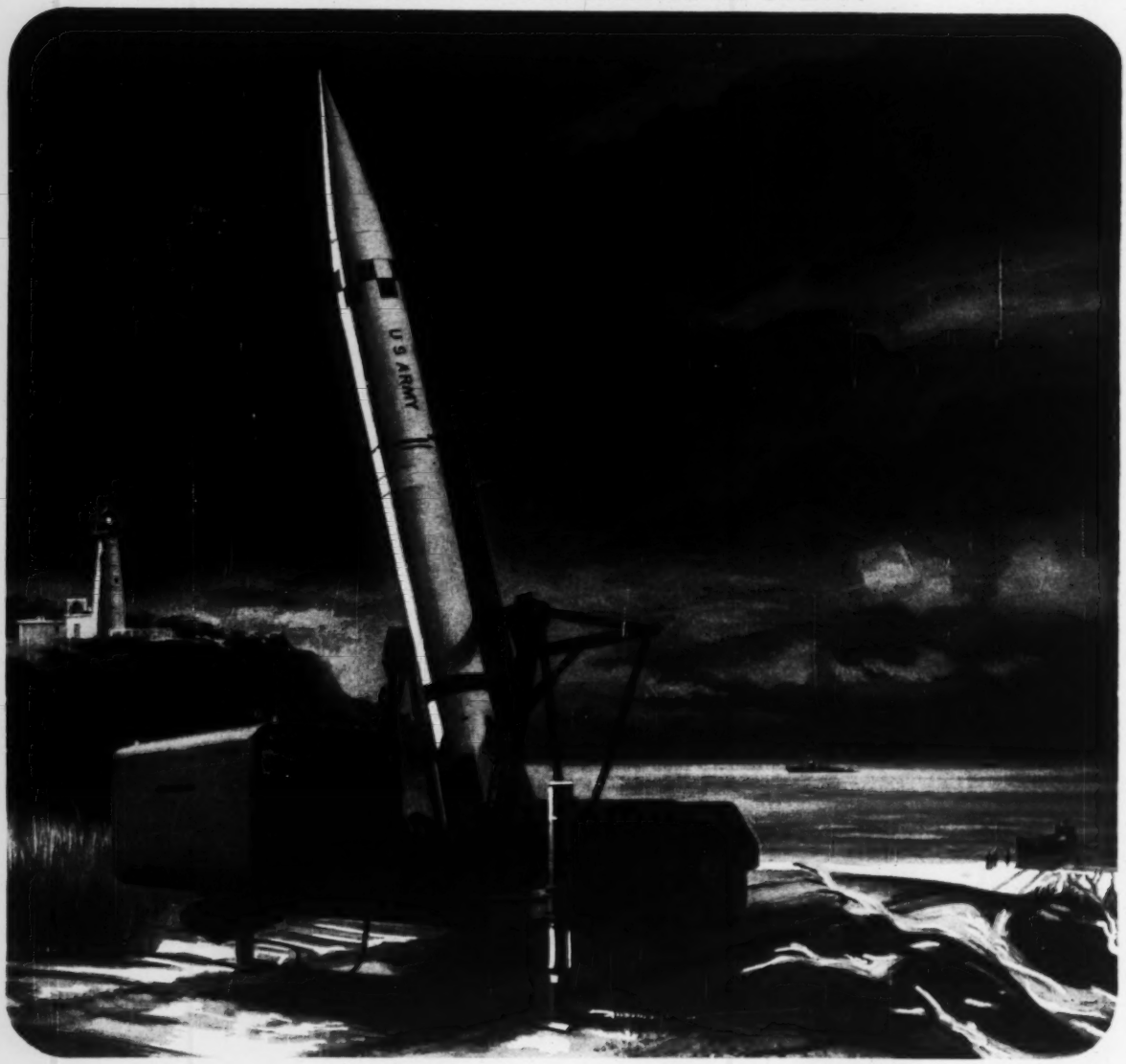
Buffalo Pumps Division • Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING
FORCED DRAFT COOLING HEATING PRESSURE BLOWING

NOTABLE ACHIEVEMENTS AT JPL . . .



PIONEERS IN MOBILE MISSILE SYSTEMS

The "Sergeant's" excellent mobility characteristics, including the ability to operate under conditions of winter snow, ice, mud, desert sand and heat, significantly extend the capabilities of the system for close support of a ground command in our modern United States Army. The ease of operation and handling permits the weapon to be unloaded from airplanes or landing craft and be ready for firing with a minimum of preparation.

The system concept demonstrated in the "Sergeant" has permitted excellent mobility and speed of operation to be attained. The requirements of the Army have been stressed, resulting in outstanding characteristics of the weapon meriting the title of "America's first truly 'second generation' surface-to-surface tactical missile."

The responsibility for accomplishing this important achievement has been placed on JPL by the United States Army Ordnance Missile Command.

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A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA • CALIFORNIA

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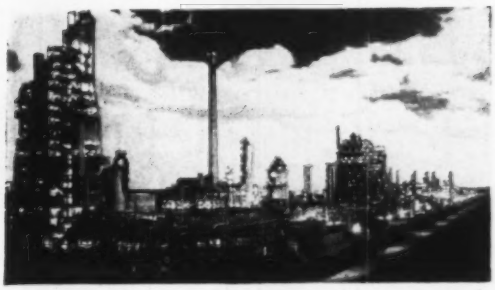


A plant built on the philosophy of "don't accept anything at face value"...

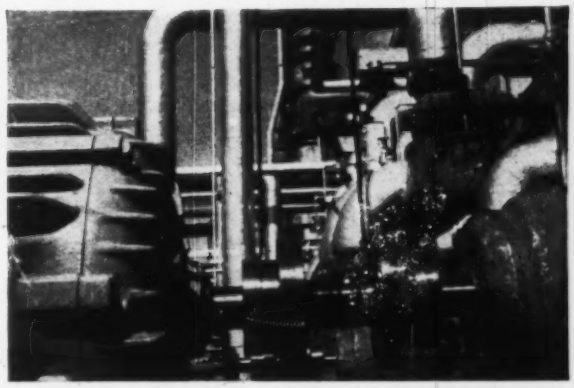
Tidewater's "Refinery of the Future" Uses 471 Fast's Couplings to Reduce Maintenance

IN PLANNING Tidewater's Delaware Refinery, all equipment purchases were examined from every angle . . . capital investment, manpower, maintenance and reliability. Fast's Self-Aligning Couplings were used throughout because they met Tidewater's exacting demands.

Tidewater's equipment design policies were established by survey teams that visited refineries all over the country. They carefully appraised each plant and asked operators what improvements they would make and what features they would retain if they were to redesign their drives.

In 471 applications at this refinery, Fast's Couplings guarantee mechanical flexibility that eliminates costly shutdowns and expensive shaft replacements. Fast's have the reputation of frequently outlasting the equipment they connect. This means savings in maintenance and down-time . . . in addition to protecting costly equipment against errors of alignment.

Nearly 40 years of coupling experience qualifies Koppers to solve *your* coupling problem. Write today for full details to: KOPPERS COMPANY, INC., Fast's Coupling Dept., 3412 Scott Street, Baltimore 3, Md.



Fast's Couplings give dependable, trouble-free service throughout Tidewater's entire production facilities.

This Fast's Coupling drives a pump delivering heavy naptha to the Solutizing plant.

Engineered Products
Sold with *Service*

KOPPERS

THE ORIGINAL
FAST'S Couplings

HELP US KEEP THE THINGS WORTH KEEPING

All is calm, all is bright. In America we are free to worship as we please, where we please. And we worship in peace.

But like so many precious things, peace doesn't come easy. Peace costs money.

Money for strength to keep the peace. Money for science and education to help make peace lasting. And money saved by individuals.

Your Savings Bonds, as a direct investment in your country, make you a Partner in strengthening America's Peace Power.

The chart below shows how the Bonds you buy will earn money for you. But the most important thing they earn is *peace*. They help us keep the things worth keeping.

Think it over. Are you buying as many Bonds as you *might*?

HOW YOU CAN REACH YOUR SAVINGS GOAL WITH SERIES E BONDS *(in just 8 years, 11 months)*			
If you want about	$2,500	$5,000	$10,000
each week, save	$4.75	$9.50	$18.75

This shows only a few examples. You can save any sum, buying Bonds by Payroll Savings or where you bank. Start your program now!

HELP STRENGTHEN AMERICA'S PEACE POWER

BUY U. S. SAVINGS BONDS

The U.S. Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, The Advertising Council and this magazine.

COMPACT REACTOR PROJECT

WILL YOU HELP US PUT A NUCLEAR REACTOR INTO ORBIT?

"Develop a nuclear power plant so compact it can be carried by a reconnaissance satellite."

That's the newest project we're working on at Atomics International—one of the most far-reaching we've ever tackled.

We're excited by the scientific advances this reactor will make possible... sobered by the magnitude of the job that lies ahead.

That is why we are making this frank appeal for help to senior-level engineers and scientists. We need your knowledge and your single-minded enthusiasm to help us speed the day this compact reactor will begin to give unending power to a satellite in Outer Space.

This is a vanguard opportunity for the dedicated atomic engineer or scientist. You'll be working with one of America's major builders of power reactors—a company that is growing steadily and rapidly.

Rewards are commensurate with ability. Advancement can be rapid. You'll work in the suburban San Fernando Valley near Los Angeles, in a community that has become a worldwide center of nuclear technology.

We'd like to talk with you—about your future and ours.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

We're looking for men to fill these jobs:

Senior-level assignments for experienced engineers and scientists in reactor and equipment development on compact reactors and power conversion systems and in specialized problems of instrumentation. Other career positions in:

Analytical Techniques: preliminary engineering, shielding, reactor core studies, systems, control, heat transfer and fluid flow, stress, start-up, operations.

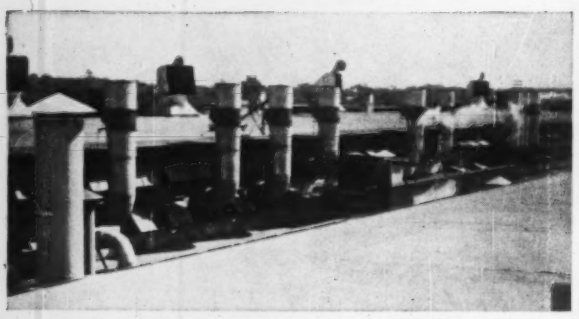
Component Development: fuel materials, irradiation and hot lab operations, fuel fabrication.

Research: reactor theory, experimental physics, solid state metallurgy and ceramics, chemistry (physical, organic, inorganic).

Please write: Mr. A. M. Newton, Personnel Office, Atomics International, 15330 Raymer Street, Van Nuys, California.

the downturn

and upturn at KVP



Same picture — different setting. Top shows complicated, space-wasting duct system which routed fumes back into plant for discharge through stacks. Bottom shows nine new 36" Aerovent "SP-7" Duct Fans installed to take fumes *up* and *out*, saving valuable floor space in busy working area. Just one of hundreds of successful Aerovent installations characterizing modern air engineering in action.

Write for free BULLETIN 400

All Aerovent Fans are rated in accordance with the Standard Test Code and U.S.D.C. Comm. Std. CS178-51.

Aerovent FANS

Aerovent

FAN COMPANY, INC.

ASH and BEACH STS. • PIQUA, OHIO

Member Air-Moving and Conditioning Assn. (AMCA)

NEW 1100 SERIES GAUGE PROTECTOR VALVE...

By Circle Seal... for instant, precise shutoff from over-pressure... even at low settings

provides complete protection for gauges and operating personnel ...accurate, immediate response ...for gas and liquid systems... actuation from 5-2400 psi

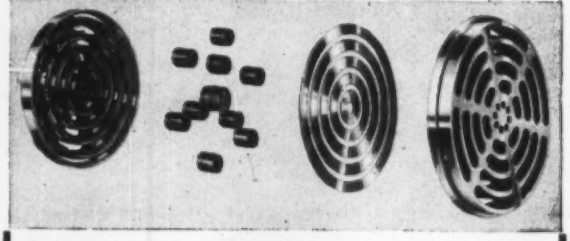
Complete engineering data available. Write today!

CIRCLE SEAL PRODUCTS COMPANY, INC.
2181 East Foothill Boulevard
Pasadena, California

Circle Seal

install J.H.H. VOSS VALVES in your compressors for peak performance

(AIR • GAS • AMMONIA)



Peak performance, maximum efficiency, greater output, and lower power costs can be built into your oldest, and of course your newest, compressors by the installation of VOSS VALVES.

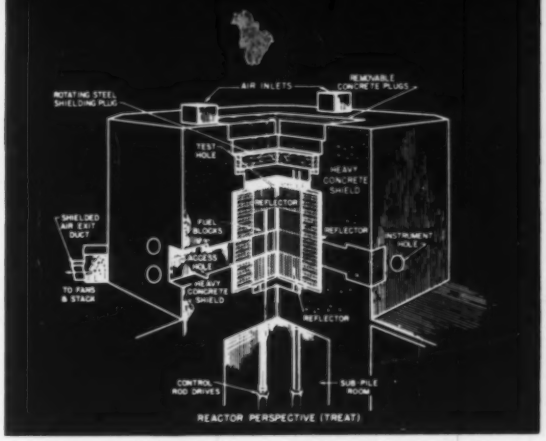
Check THESE VOSS VALVE ADVANTAGES:

- Quiet, vibration-free operation
- 20 to 60% more valve area
- less power consumption
- minimum pressure loss
- normal discharge temperature
- lower operating costs
- utmost safety

Our detailed proposal for increasing efficiency of your compressor will be sent without obligation. Send name, bore, stroke, and speed of your machine.

J.H.H. VOSS VALVES

J. H. H. VOSS CO., INC.
785 East 144th St., N. Y. 54, N. Y.

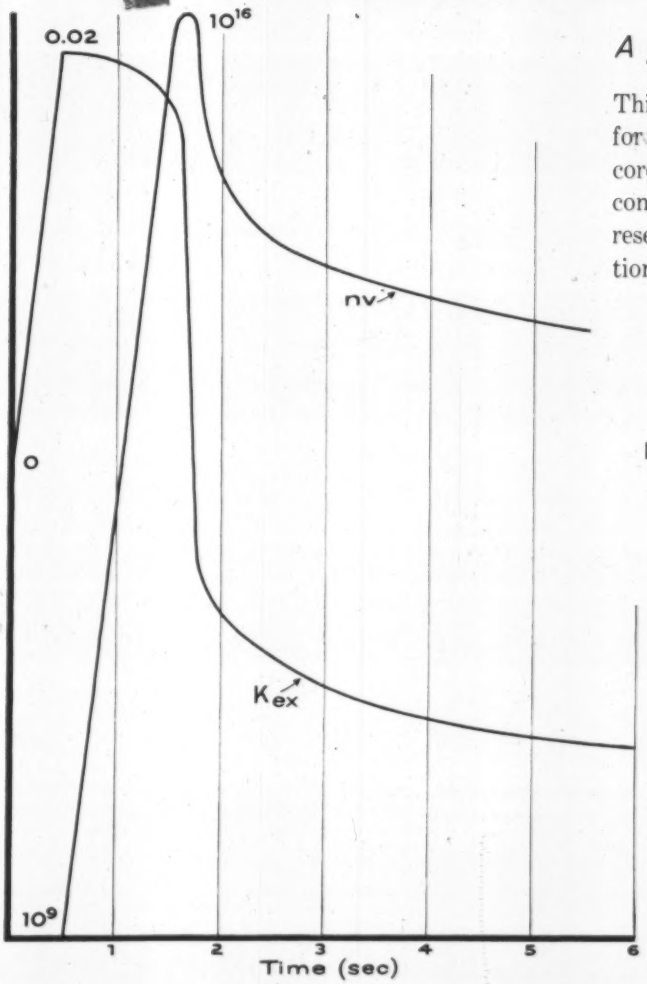


REACTOR PERSPECTIVE (TREAT)

TREAT is a highly flexible experimental reactor complete with provisions for viewing and photographing the progress of in-pile experiments.

TREAT

TRANSIENT REACTOR TEST FACILITY



A pulsed urania-graphite reactor

This reactor is the first being built specifically for testing the response of fuel elements and core components to simulated nuclear excursion conditions. This is an example of Argonne's research leadership in new concepts and applications for fission reactors.

Staff positions available for qualified
Mathematicians, Physicists, Chemists
Physical Metallurgists, Chemical Engineers
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NATIONAL LABORATORY
Operated by the University of Chicago under contract with the United States Atomic Energy Commission.

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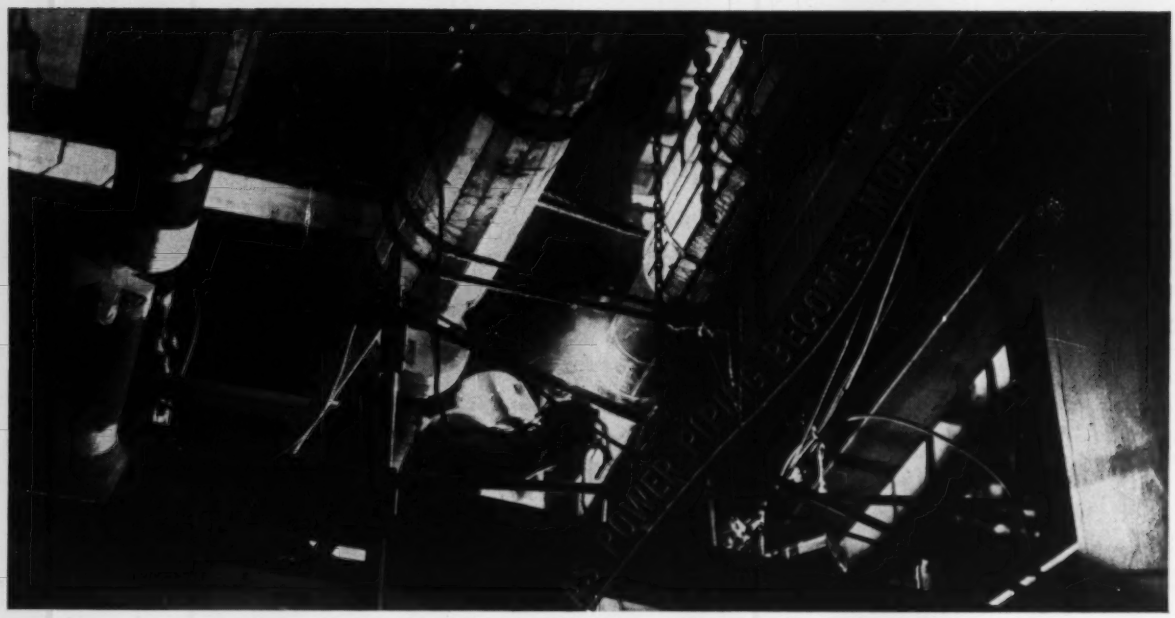
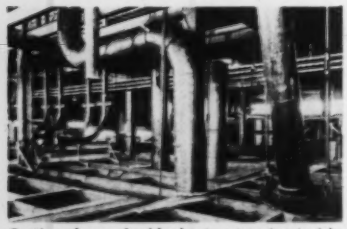


A main steam line is K-Welded to the mixing header. There are eight main steam lines to this header from the boiler, and four from mixing header to turbine. With inside diameters up to 4.938 in. and minimum wall thicknesses as much as 2.860 in., sections weigh four to five tons. Main steam header weighs over ten tons.

KELLOGG'S FIELD WELDING KEEPS PACE



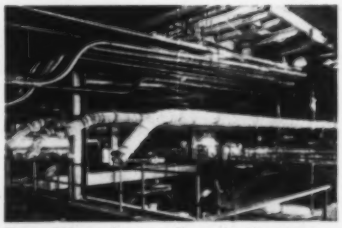
Section of second cold reheat system (center) in process of being positioned, with section of first cold reheat system (right) partially in place. Four boiler feed risers at left.

General view inside Eddystone Station, eleven floors high, showing high pressure boiler feed water risers (top and center) as these were being erected by Kellogg.

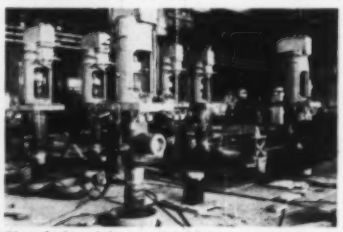
During erection of Philadelphia Electric Company's Eddystone Station, Unit No. 1, *eighty* K-Welds® . . . Kellogg's inert gas shielded technique of manual arc welding . . . will be made by Kellogg on the Type 316 stainless main steam lines alone. Following Kellogg's shop fabrication procedures on this job, every K-Weld will be given a total of *four* inspections by liquid penetrant and radiography during welding and after heat treatment.

Time required to finish and inspect each weld completely on this supercritical, heavy-walled piping is *eight to ten working days*. Further evidence of the magnitude and complexity of Kellogg's erection and welding assignment is provided by these construction photographs.

Kellogg welcomes inquiries on its complete service to the power piping industry from consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and allied equipment.



Four of the main steam lines, showing the protective wood lagging installed at Kellogg plant. This is not removed, except at welding points, until insulation is applied.



Six of the eight special high pressure valves being installed by Kellogg at the Eddystone Station—Philadelphia Electric Company's new supercritical steam power plant.

Fabricated Products Sales Division, THE M. W. KELLOGG COMPANY, 711 Third Avenue, New York 17, N. Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

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ANSWERS to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

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OPPORTUNITY FOR MECHANICAL ENGINEERS

Challenging positions available in Engineering Department of new synthetic textile fiber producing plant. Opportunities in project engineering in connection with continuing expansion program. Work involves designing, contractor liaison, supervision of draftsmen, construction, and equipment installation inspection.

Requires: Recognized college degree in Mechanical Engineering, high academic standing. Two to four years' industrial project engineering experience desirable but not essential. Reply with full resume to:

TECHNICAL EMPLOYMENT DEPARTMENT
THE DOW CHEMICAL COMPANY
WILLIAMSBURG, VIRGINIA

CHIEF ENGINEER

44000KW Steam Generating Plant now under construction, Sea Coast, Southern Peru, the applicant must be capable of taking responsibility for Operation and Maintenance. Should have five to ten or more years' central station experience. For details as to salary, living conditions contact, **Mr. John L. Splane, 410 Arizona Land Title Building, Tucson 1, Arizona.**

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Graduate mechanical engineer in power plant design work. Experience not required. Excellent opportunity with consulting engineering firm in the Middle West. Liberal benefit plans and good working conditions.

Send resume of education and experience with statement of salary requirements.

Address CA-5905, % "Mechanical Engineering."

Mechanical Engineer

To design and test new food processing equipment and packaging machinery.

BSME with sound background in math, mechanics, thermodynamics, stress analysis, and fluid flow. Experience in above fields desirable.

- career opportunity
- relocation allowance
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send complete resume to:

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Personnel, Room 8/218
Central Research Laboratories
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New, challenging positions continue to develop for mechanical engineers with good creative ability who are able to conceive, plan, and carry through to successful completion unusual mechanical research and development projects. Diversified program includes projects in machine design and development, stress analysis, vibrations, internal combustion engines, propulsion, equipment systems, instrumentation, reactor engineering and related fields. Beginning salaries commensurate with training and experience. Merit advancement, unusual vacation policy, attractive educational program with The Ohio State University, and many other benefits. Please write today for prompt consideration to

The Personnel Manager

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Combustion Engineer

To study and recommend the most effective use of conventional and special fuels in hypersonic air-breathing propulsion systems. Will evaluate combustion qualities of various types of fuel, then develop appropriate combustor designs. Experience in fuels chemistry and internal flow systems is desirable.

Position is in ASTRO, Marquardt's Air Space Travel Research Organization. Here you will work with other engineers and scientists on several long term projects aimed at new and broader uses of ramjet engines and other advanced propulsion cycles for air and space application.

Marquardt, recognized as a leader in the propulsion field, is advancing in many areas of advanced power systems and related fields. This may offer you the opportunity you seek. Contact:

Floyd E. Hargiss, Manager, Professional Personnel
16550 Saticoy Street, Van Nuys, California

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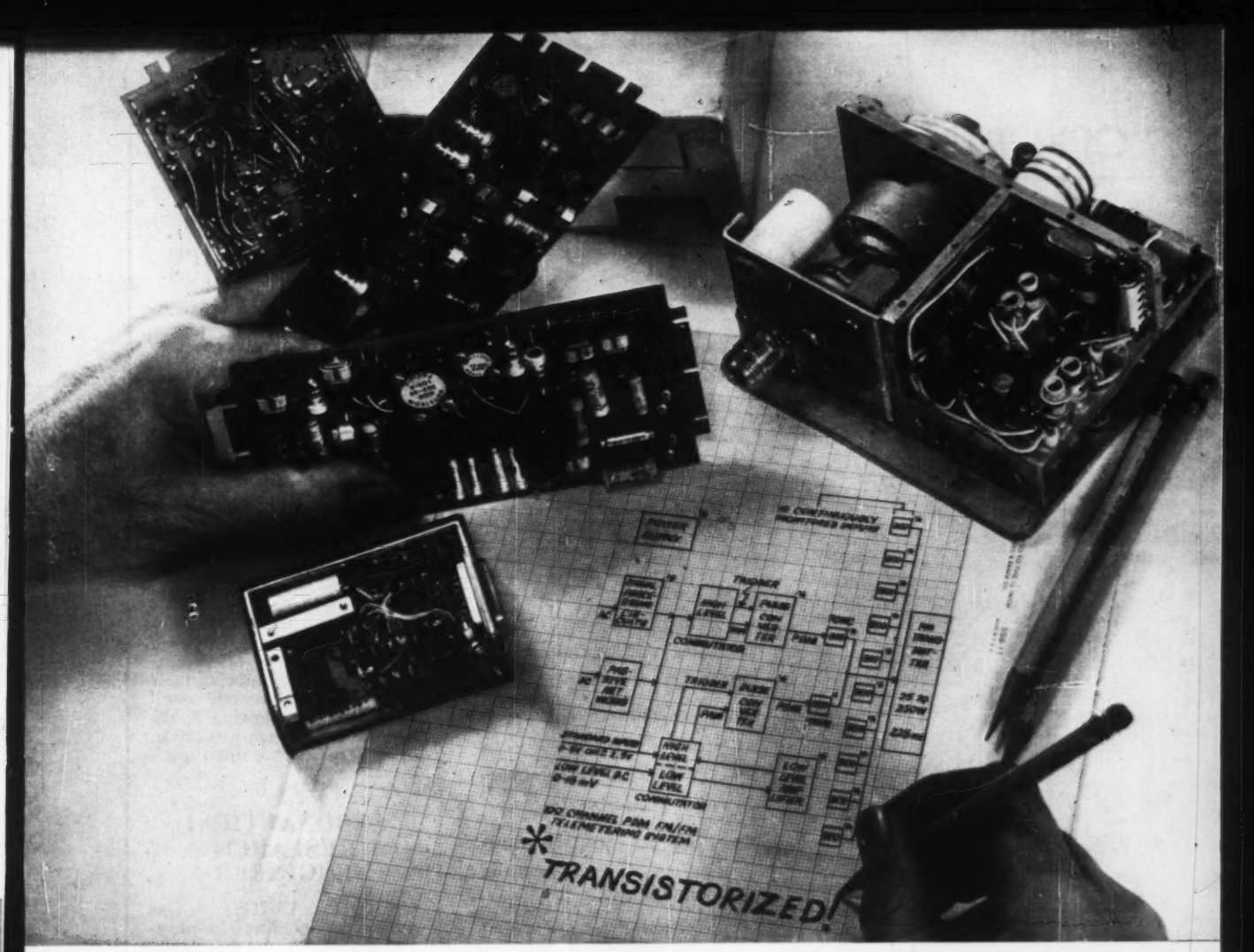

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Div. Dresser Industries (Inc.)
Pantex Mfg. Corp.
*Patterson Kelley Co.
Perfection Gear Co.
American Stock Gear Div.
Permutit Co.
Div. Pfaudler Permutit (Inc.)
*Philadelphia Gear Corp.
Pittsburgh Piping & Equipment Co.
*Posey Iron Works
Precision Rubber Products Corp.

Raybestos-Manhattan
Manhattan Rubber Div.
Packing Div.
Reliance Gauge Column Co.
Republic Flow Meters Co.
Sub. Rockwell Mfg. Co.
Rhopac (Inc.)
Ric-Wil (Inc.)
Riley Stoker Corp.
Ronald Press Co.
*Roots-Connersville Blower Div.
Dresser Industries (Inc.)
Rust-Oleum Corp.

Sheffield Corp.
Shell Oil Co.
Shenango Furnace Co.
Sly, W. W., Mfg. Co.
Smith, S. Morgan, Co.
Spraying Systems Co.
Stephens-Adamson Mfg. Co.
Stewart-Warner Corp.
Alemite Div.
Streeter-Amet Co.
*Struthers Wells Corp.
Div. Titusville Iron Works
Sturtevant, P. A., Co.
*Syntron Co.

*Taylor Forge & Pipe Works
*Taylor Instrument Cos.
Technical Charts (Inc.)
*Titusville Iron Works Co.
Div. Struthers Wells Corp.
*Tube Turns
Div. of Chemetron Corp.

*Union Iron Works
Universal Drafting Machine Corp.
Universal Tube Corp.

Vapor Heating Corp.
Venus Pen & Pencil Corp.

Wabash Metal Products Co.
Walworth Co.
Western Gear Corp.
Westinghouse Elect. Corp.
Sturtevant Div.
*Wheeler, C. H., Mfg. Co.
White, H. P., Laboratory
*Wickes Boiler Co.
Div. of Wickes Corp.
Wiegand, Edwin L., Co.
Wiley, John & Sons
Williams Gauge Co.
Wollensak Optical Co.
Worcester Valve Co.
*Worthington Corp.

*Yuba Heat Transfer Div.
Yuba Consolidated Industries

*Zallea Bros.
Zonolite Co.
Z-Crete Div.

CEC's new ceramic insulator for temperature, pressure, and shock

ceramicite

Because of Ceramicite's ability to bond physically with metals... and because of its exceptional dielectric characteristics, high-temperature capabilities, and pressure integrity... *new reliability can be yours in:*

PRE-FORMED BEADS—Ready for firing by the customer, beads are offered in nine standard sizes and three Ceramicite materials for hermetic seals in different metals. Custom designs are produced for specific applications.

HERMETIC SEALS—Ceramicite seals are designed for high-temperature AN and miniature connectors, non-magnetic terminals for inertial guidance systems, receptacles for missile igniters, headers and bases for transducers, relays, and semiconductors.

COATINGS—Ceramicite provides an oxide-preventive, high-dielectric coating for stainless steel, titanium, K-monel, Inconel-X, and other uncommon metals in high-temperature and nuclear radiation applications.

MAGNET WIRE—Ceramicite-coated 1000°F magnet wire is now being manufactured by Hi-Temp Wires, Inc., Westbury, N.Y., and Sequoia Wire & Cable Co., Redwood City, Calif., under license agreement to CEC.

Write for Bulletin CEC 1590-X5 for the details on this exciting new development.

Transducer Division CEC

Consolidated Electrodynamics

300 North Sierra Madre Villa, Pasadena, California

RECOGNIZED LEADER IN GALVANOMETERS—TELEMETRY, PRESSURE AND VIBRATION INSTRUMENTATION

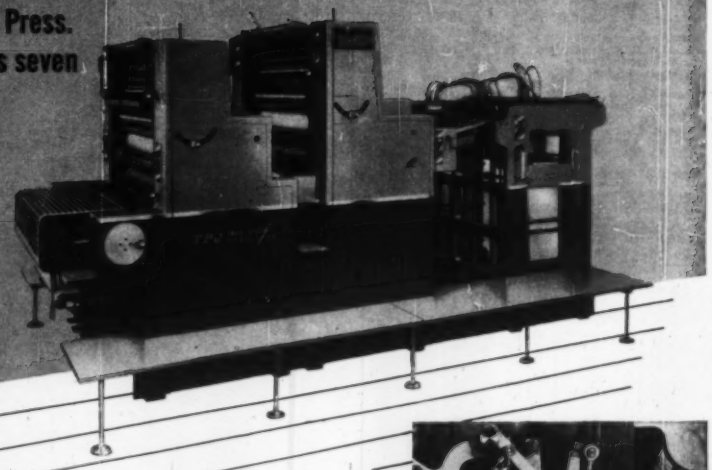
For employment opportunities with this progressive company, write Director of Personnel.

Misalignment is compensated for *Automatically*

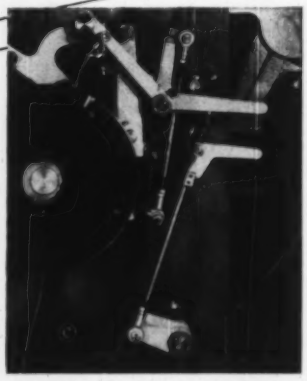
The Miller Printing Machinery Co. has introduced the Miller TPJ Two Color-Perfector Offset Press. In the design of this press, Miller uses seven

HEIM *Unibal*®

SPHERICAL BEARING ROD ENDS

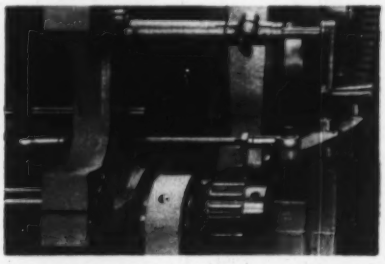


The TPJ is a sheet-fed offset press which converts from printing two colors on one side of the sheet to one color on both sides of the sheet. It can be switched from one to the other in a matter of minutes. It operates at high speeds and prints sheets up to 23" x 36".



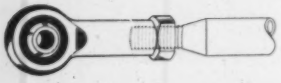
Major section of the first unit trip linkage, where Unibal Rod Ends were chosen to compensate for any slight misalignment, and because they are less expensive than special connections for this application.

These were chosen for several reasons, the principal one being that dimensional and squareness tolerances do not have to be held as close when using the Unibal, as any misalignment is compensated for automatically. The Heim Unibal has a single ball rotating in bronze raceways housed in an outer member or cartridge. The single ball has universal motion to correct misalignment . . . the larger surface supporting area offers greater load ratings for substantially smaller dimensions . . . assembly is simple and fast . . . there is a wide choice of sizes in both male and female types.



Portions of the side guide operating mechanism showing the use of Unibal Rod Ends to connect a walking motion operated by a face cam to a transverse motion.

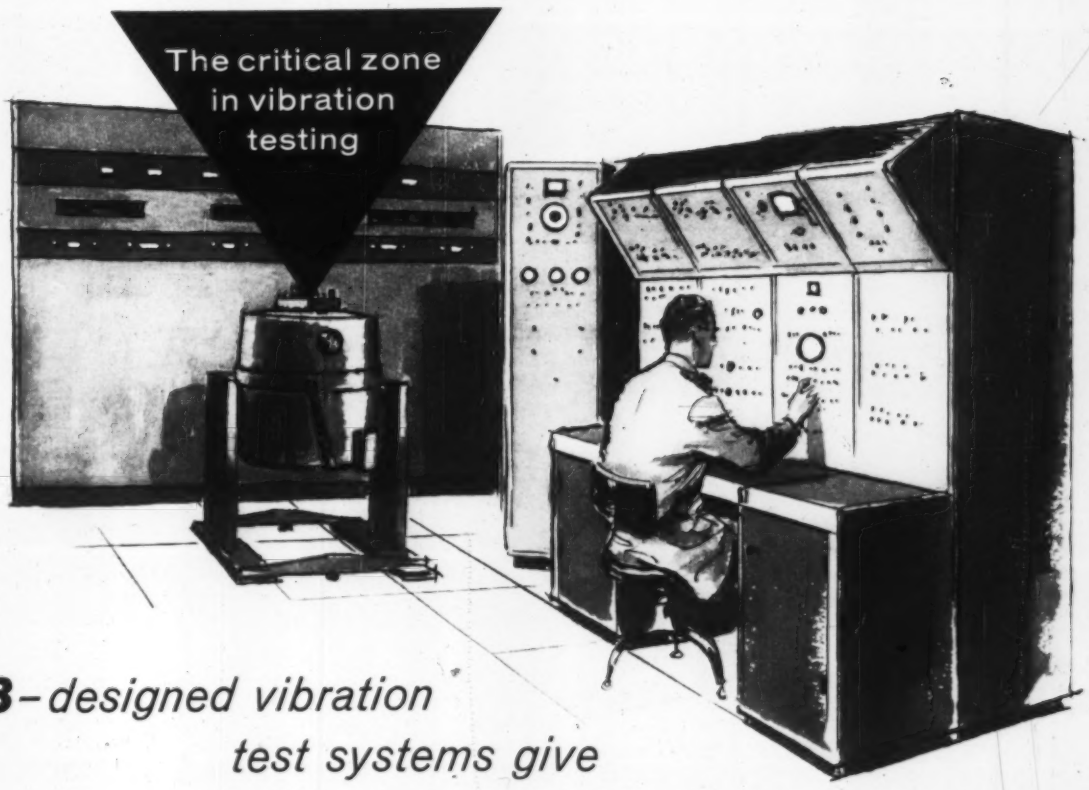
Heim bearings are sold through the country's leading bearing distributors. Write for complete catalog and/or engineering help.



THE HEIM COMPANY

FAIRFIELD, CONNECTICUT

SPECIFY HEIM UNIBAL SPHERICAL BEARINGS AND ROD ENDS FOR ALL PUSH-PULL AND LINKAGE APPLICATIONS AND WHERE MISALIGNMENT MUST BE COMPENSATED FOR



MB–designed vibration test systems give

high performance table motion

It's *System Performance* that counts most in vibration testing.

Whole purpose of a vibration test system, large or little, is to subject specimens to *motions* that simulate service conditions as closely as possible. Such motion gives you *reliable* information on vibratory response and performance of structures, products, components. It helps reduce risk of malfunction or failures in the field.

But many factors contribute to this motion. Among them: force output and characteristics of the exciter; ample and undistorted power supply to meet all shaker-plus-specimen load relationships; meticulous matching of components in the entire system from input signal to output at the shaker table.

INTEGRATED SYSTEM OFFERS OPTIMUM RESULTS

As the manufacturer of *complete* systems, MB intimately knows the operational needs of shaker, builds amplifiers and controls around those needs. Each MB system is integrated toward the highly desired end result . . . *delivering optimum performance at the shaker table* for present and future needs.

The largest field service organization in vibration testing is ready to help you achieve that result. For latest information, call on MB.

HIGH FORCE HIGH PERFORMANCE SYSTEM

Shown above is a typical MB test system. It includes a Model C70 7000 pound force vibration exciter fit for environmental testing chambers.

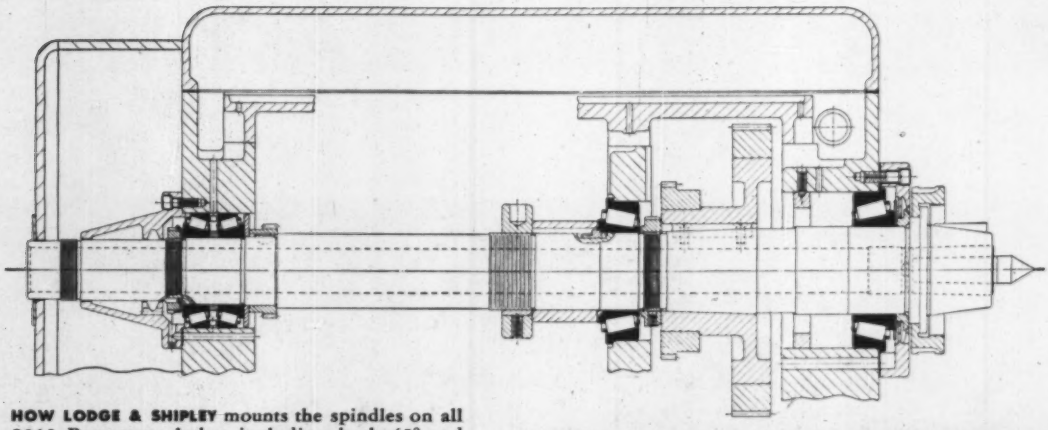
The MB T996 amplifier is rated at 50KVA output and can handle the most adverse reactive shaker loads for broad-band sine wave and random motion testing. The T68MC control console is easy to use, also provides automatically cycled testing. The T88 console expands system for complex motion work.

Send for Bulletin 470 which gives detailed specifications on the high performance available from this system; and from others to 25,000 pounds force.

largest producer of complete systems for vibration testing

MB manufacturing company
A Division of Textron Inc.

1074 State Street
New Haven 11, Conn.



HOW LODGE & SHIPLEY mounts the spindles on all 2013 Powerturn lathes including both 45° and 90° Copymatics on Timken bearings to get extra rigidity, maintain accuracy, reduce maintenance.

New type lathe ups production 200%, saves users an estimated $8,000 a year

...one secret—TIMKEN® bearings on the spindle

"Production increases as high as 200%"..."Overall savings estimated at $8,000 a year"—read user reports about the new 2013 Powerturn 90° Copymatic Lathe. One important reason for such exceptional results is that Lodge & Shipley mounts the spindle on Timken® tapered roller bearings. Timken bearings give it the vital extra rigidity and hold runout to the minimum needed for tracer accuracy.

How spindle is held rigid. Timken bearings hold the spindle in positive alignment. They take *both* radial and thrust loads in any combination, because of their tapered design. And because of full line contact between rollers and races, Timken bearings have extra load-carrying capacity.

Why heavy shocks are absorbed. Case-carburization of Timken bearings' rollers and races gives them hard, wear-resistant surfaces and tough, shock-resistant cores.

How friction is virtually eliminated. Timken bearings are geometrically designed to roll true. And they're precision-made to live up to their design. They run smoother—last longer.

We even make our own electric furnace fine alloy steel, for extra quality control. We're America's only bearing maker that does. To get all these advantages, always specify bearings trade-marked "TIMKEN". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

TIMKEN *TAPERED ROLLER BEARINGS ROLL THE LOAD*

TRADE-MARK REG. U. S. PAT. OFF.